US011120378B1

(12) **United States Patent**
Willard, III et al.

(10) **Patent No.: US 11,120,378 B1**
(45) **Date of Patent: *Sep. 14, 2021**

(54) **SYSTEM AND METHOD FOR PERFORMING BULK PICK OF ITEMS OF A CUSTOMER ORDER**

(71) Applicant: **America's Collectibles Network, Inc.**, Knoxville, TN (US)

(72) Inventors: **George F. Willard, III**, Knoxville, TN (US); **Mahendra Satrasala**, Knoxville, TN (US); **Lei Cao**, Oak Ridge, TN (US); **G. Shannon Meade**, Knoxville, TN (US); **Bradley K. Waller**, Lenoir City, TN (US); **Matthew Cardwell**, Knoxville, TN (US)

(73) Assignee: **America's Collectibles Network, Inc.**, Knoxville, TN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/514,897**

(22) Filed: **Jul. 17, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/700,619, filed on Jul. 19, 2018.

(51) **Int. Cl.**
G06Q 10/00 (2012.01)
G06Q 10/06 (2012.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G06Q 10/06315*** (2013.01); ***G06F 16/29*** (2019.01); ***G06F 16/9024*** (2019.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,346,564 B1 * 3/2008 Kirklin G06Q 10/087 705/26.1
7,739,138 B2 * 6/2010 Chauhan G06Q 10/06 705/7.14

(Continued)

OTHER PUBLICATIONS

Zhao, X. (2011). A business process driven approach for automatic generation of business applications (Order No. NR78480). Available from ProQuest Dissertations and Theses Professional. (Year: 2011) (Year: 2011).*

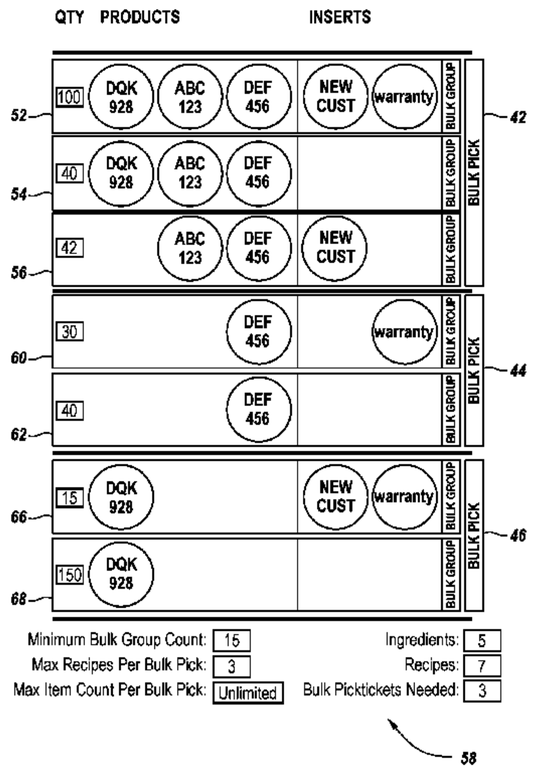
(Continued)

Primary Examiner — Gurkanwaljit Singh
(74) *Attorney, Agent, or Firm* — Nelson Mullins Riley & Scarborough LLP; Anthony A. Laurentano

(57) **ABSTRACT**

A customer order fulfillment system comprising an order collection unit for collecting information associated with a plurality of customer orders and generating related customer order data. The system also includes an order generating unit for receiving the customer order data from the order collection unit and generating in response thereto consolidated order fulfillment data, and a bulk pick order fulfillment unit for receiving the consolidated order fulfillment data from the order generating unit and grouping together similar ones of the items associated with the customer orders to form a plurality of bulk picks, wherein one or more of the bulk picks can form part of one or more bulk pick tours. The system further includes a pick tour generating unit for receiving the consolidated order fulfillment data from the order generating unit and for generating pick tour instructions associated with a pick tour from the consolidated order fulfillment data.

18 Claims, 8 Drawing Sheets



(51) **Int. Cl.**

G06Q 10/08	(2012.01)
G06Q 10/10	(2012.01)
G06F 16/29	(2019.01)
G06F 16/901	(2019.01)
G06Q 30/06	(2012.01)
G06Q 10/04	(2012.01)

(52) **U.S. Cl.**

CPC ***G06F 16/9027*** (2019.01); ***G06Q 10/047*** (2013.01); ***G06Q 10/06316*** (2013.01); ***G06Q 10/083*** (2013.01); ***G06Q 10/0875*** (2013.01); ***G06Q 10/10*** (2013.01); ***G06Q 30/0635*** (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,853,492	B1 *	12/2010	Kirklin	G06Q 10/087 705/28
8,175,925	B1 *	5/2012	Rouaix	G06Q 20/20 705/22
8,401,975	B1 *	3/2013	Tian	G06Q 10/08 705/335
8,407,110	B1 *	3/2013	Joseph	G06Q 30/0633 705/28
9,466,045	B1 *	10/2016	Kumar	G06Q 10/087
9,602,381	B1 *	3/2017	Jordan	G06Q 10/08
10,489,802	B1 *	11/2019	Zhdanov	G06Q 30/0202
2008/0301009	A1 *	12/2008	Plaster	G06Q 10/087 705/28
2011/0055289	A1 *	3/2011	Ennis	G06Q 10/06 707/805
2011/0261049	A1 *	10/2011	Cardno	G06Q 10/10 345/419
2014/0040075	A1 *	2/2014	Perry	G06Q 30/0635 705/26.81
2016/0217399	A1 *	7/2016	Roelofs	G06Q 10/08355
2019/0213530	A1 *	7/2019	Wolf	G06Q 10/043
2020/0265381	A1	8/2020	Willard, III et al.	
2020/0272970	A1	8/2020	Willard, III et al.	
2020/0311644	A1	10/2020	Willard, III et al.	

OTHER PUBLICATIONS

Kim, B. S. (2009). Dynamic slotting and cartonization problem in zone-based carton picking systems (Order No. 3394621). Available from ProQuest Dissertations and Theses Professional (Year: 2009) (Year: 2009).*

Ow Yong, M. G. (2009). Order batching design for a modular fulfillment center (Order No. 3418241). Available from ProQuest Dissertations and Theses Professional (Year: 2009) (Year: 2009).*

Frazelle, E. H. (1989). Stock location assignment and order picking productivity (Order No. 9120762). Available from ProQuest Dissertations and Theses Professional (Year: 1989) (Year: 1989).*

Van den Berg, Jeroen P., and Willem HM Zijm. "Models for warehouse management: Classification and examples." International journal of production economics 59.1-3 (1999): 519-528. (Year: 1999) (Year: 1999).*

Accorsi, Riccardo, Riccardo Manzini, and Fausto Maranesi. "A decision-support system for the design and management of warehousing systems." Computers in Industry 65.1 (2014): 175-186. (Year: 2014) (Year: 2014).*

* cited by examiner

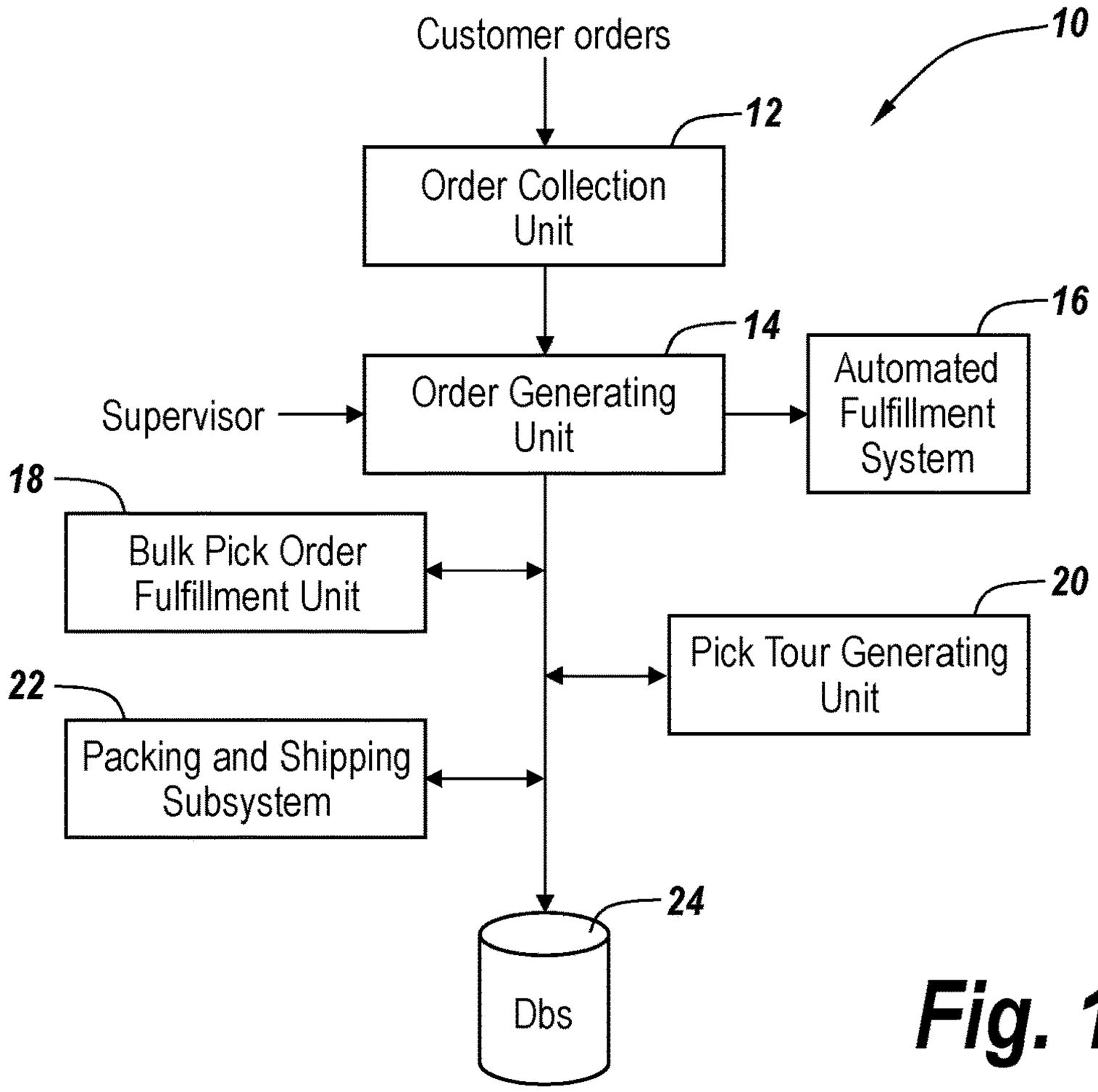

Customer orders
10
12
Order Collection Unit
14
16
Supervisor
Order Generating Unit
Automated Fulfillment System
18
Bulk Pick Order Fulfillment Unit
20
Pick Tour Generating Unit
22
Packing and Shipping Subsystem
24
Dbs

Fig. 1

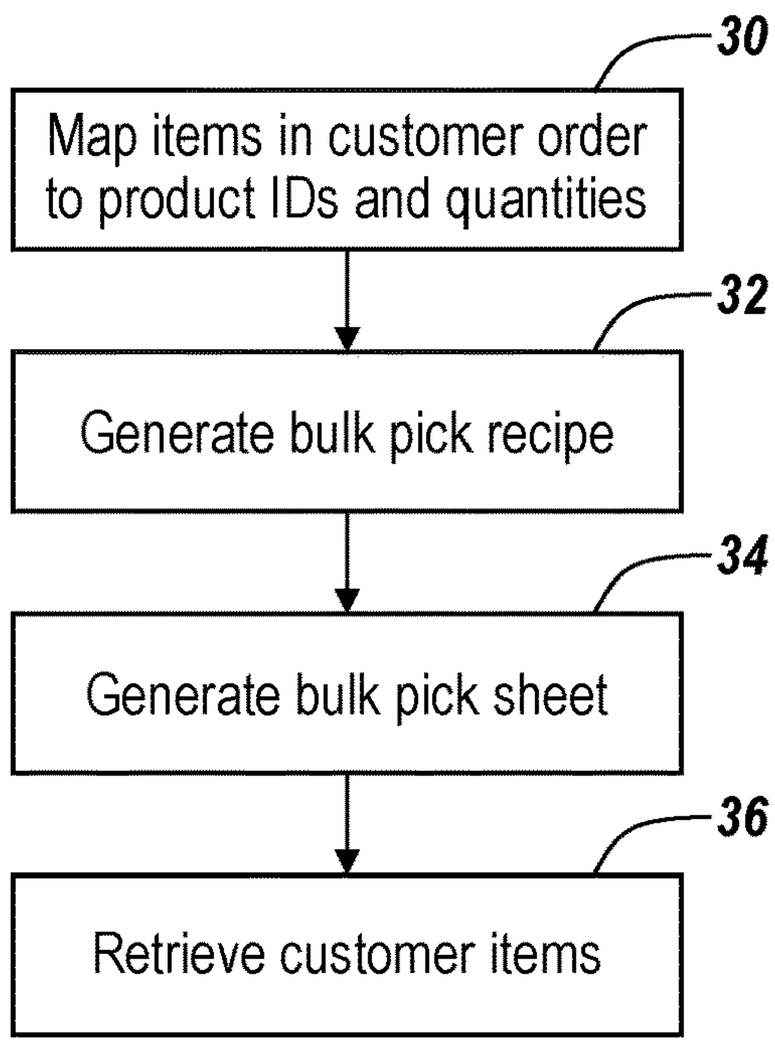

30
Map items in customer order to product IDs and quantities
32
Generate bulk pick recipe
34
Generate bulk pick sheet
36
Retrieve customer items

Fig. 2

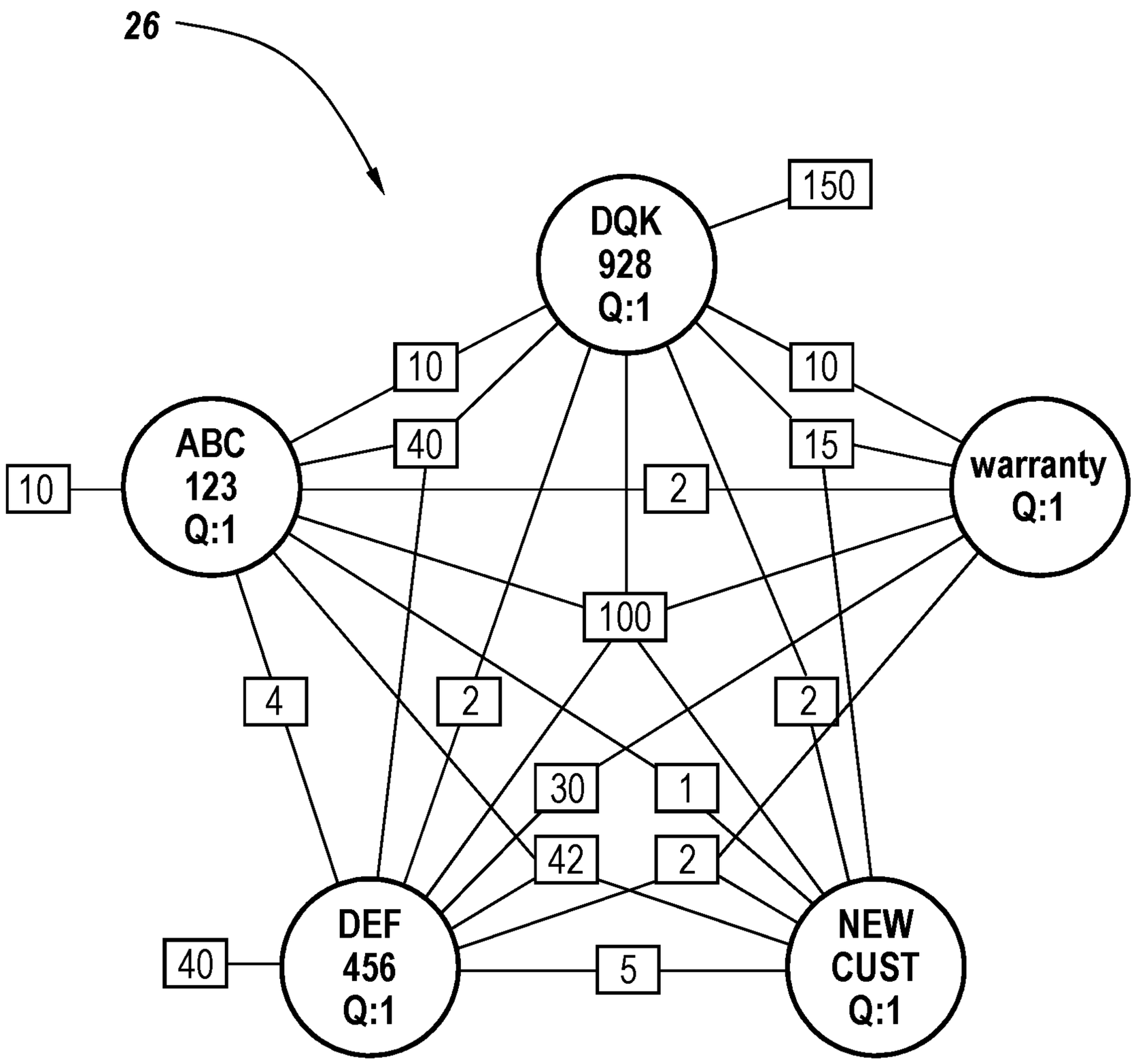

26
DQK
928
Q:1
150
10
10
ABC
123
Q:1
40
15
warranty
Q:1
10
2
100
4
2
2
30
1
42
2
DEF
456
Q:1
NEW
CUST
Q:1
40
5

Fig. 3

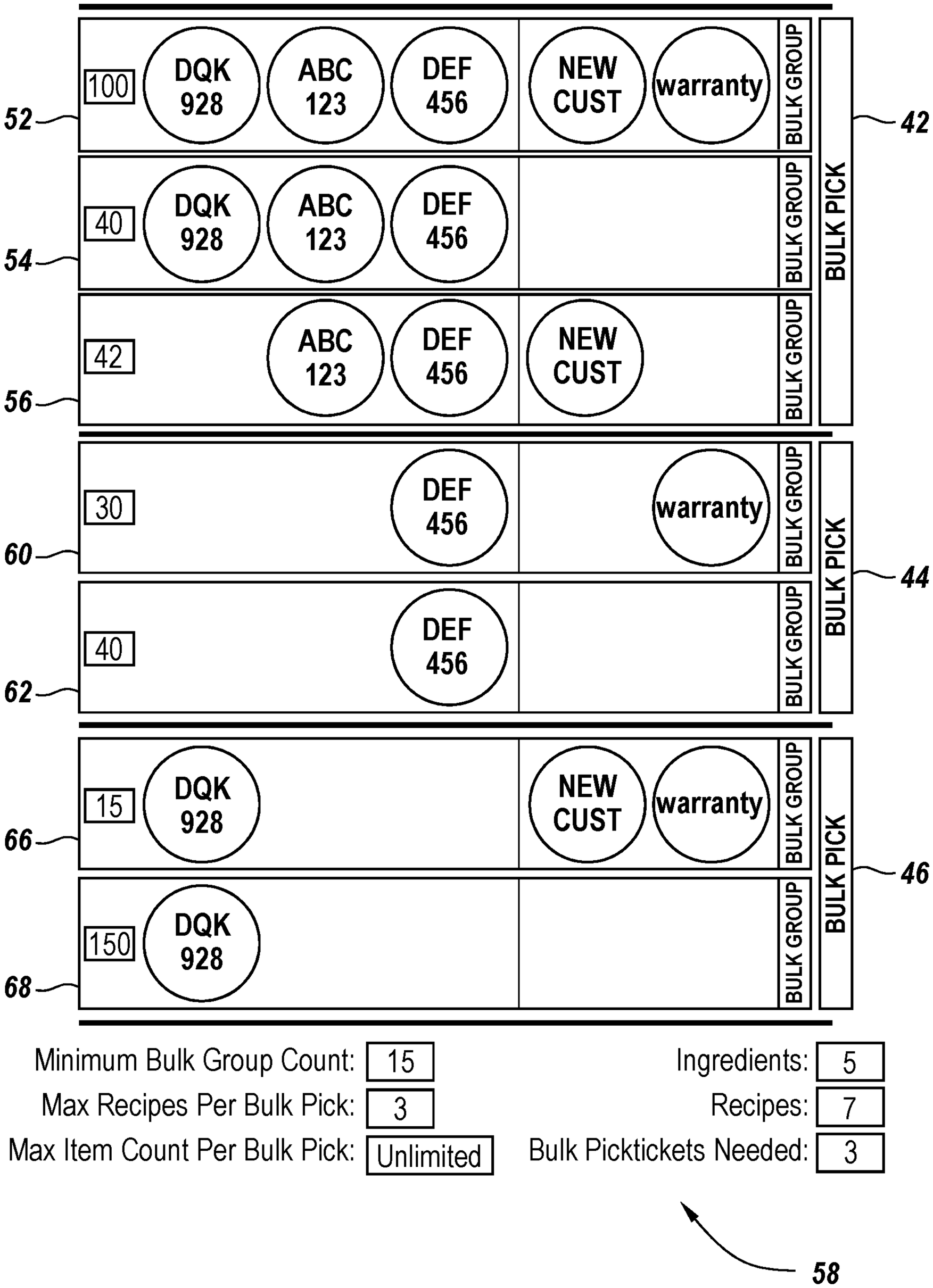

QTY
PRODUCTS
INSERTS
100
DQK 928
ABC 123
DEF 456
NEW CUST
warranty
BULK GROUP
52
40
DQK 928
ABC 123
DEF 456
BULK GROUP
54
42
ABC 123
DEF 456
NEW CUST
BULK GROUP
56
BULK PICK
42
30
DEF 456
warranty
BULK GROUP
60
40
DEF 456
BULK GROUP
62
BULK PICK
44
15
DQK 928
NEW CUST
warranty
BULK GROUP
66
150
DQK 928
BULK GROUP
68
BULK PICK
46
Minimum Bulk Group Count: 15
Max Recipes Per Bulk Pick: 3
Max Item Count Per Bulk Pick: Unlimited
Ingredients: 5
Recipes: 7
Bulk Picktickets Needed: 3
58

Fig. 4

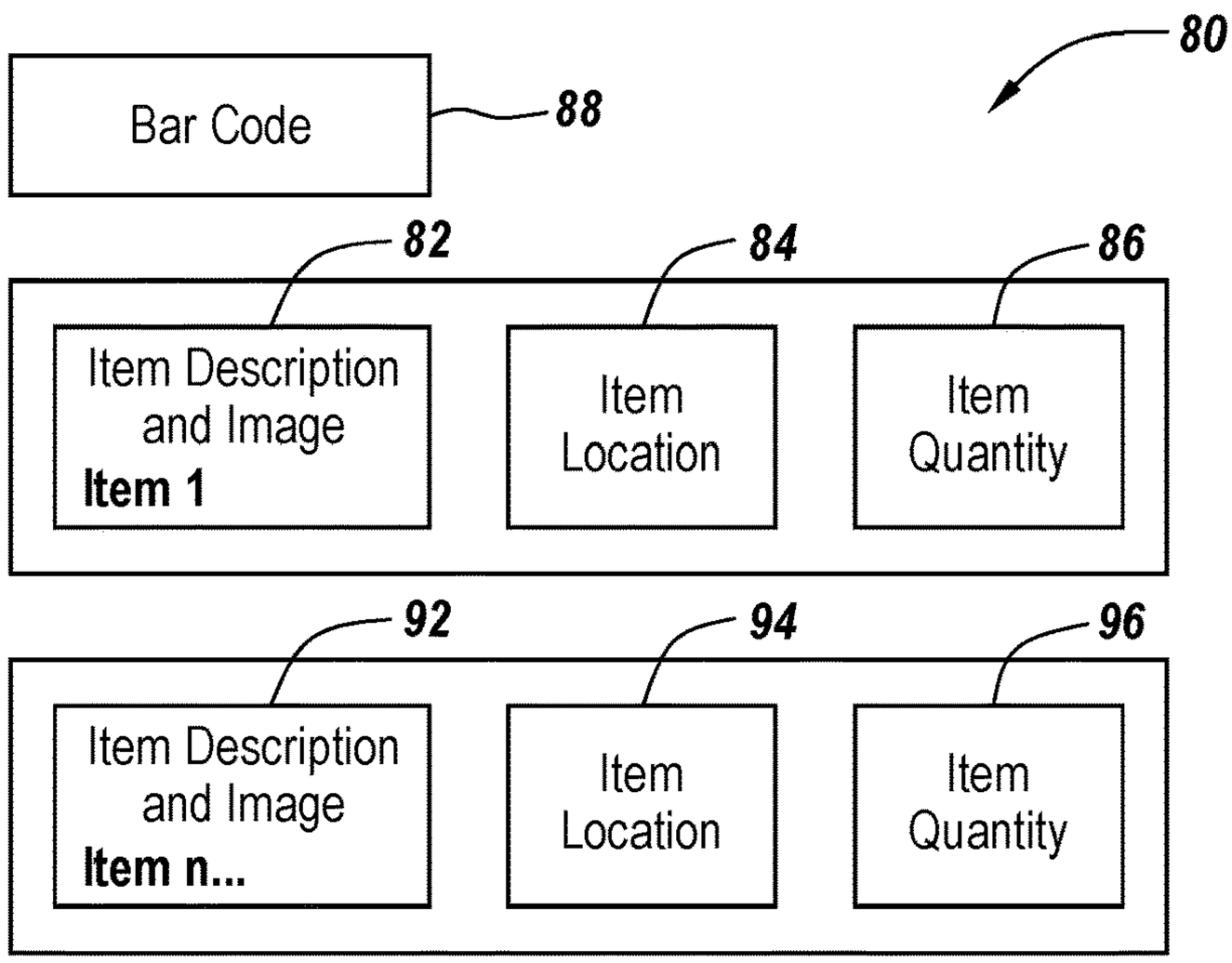

80
Bar Code
88
82
84
86
Item Description and Image
Item 1
Item Location
Item Quantity
92
94
96
Item Description and Image
Item n...
Item Location
Item Quantity
Bulk Pick Ticket

Fig. 5

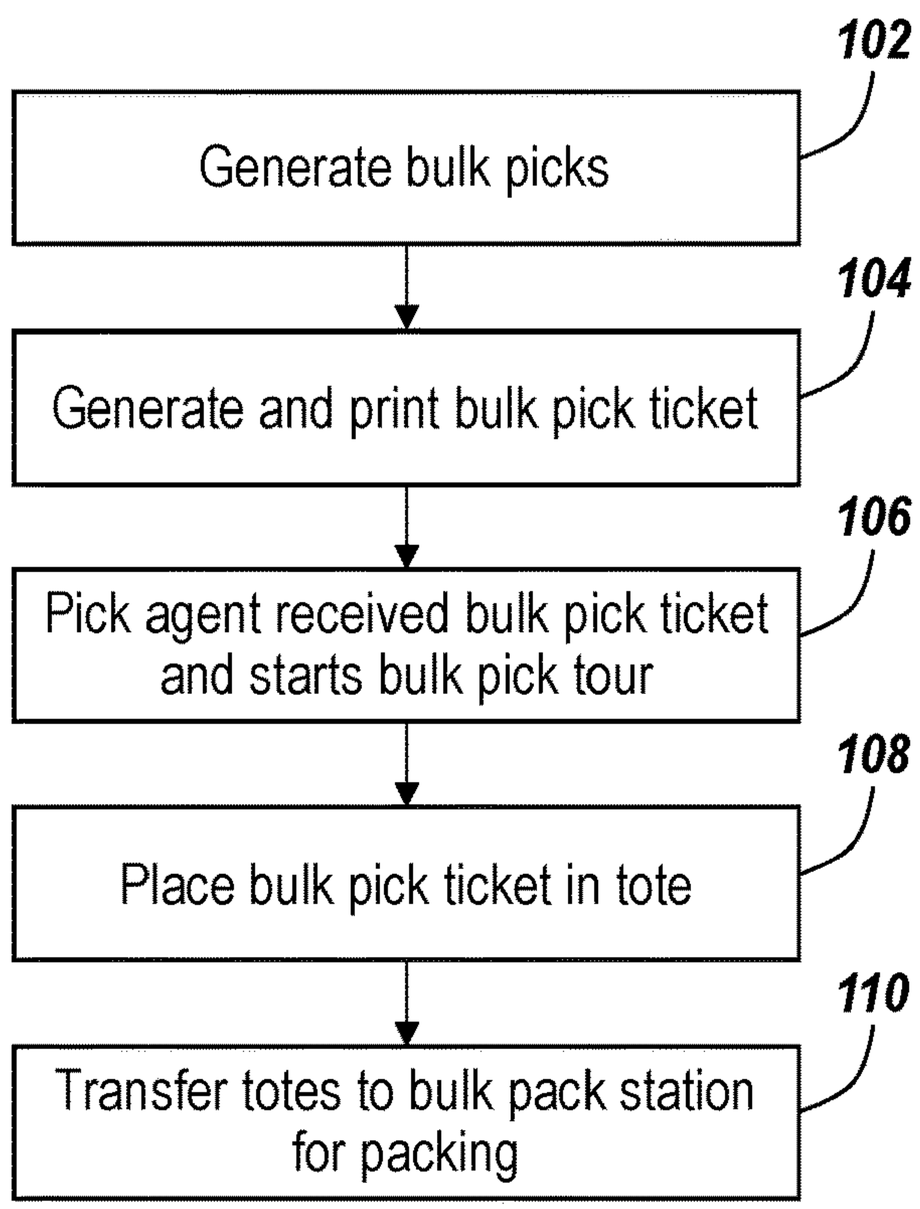

102
Generate bulk picks
104
Generate and print bulk pick ticket
106
Pick agent received bulk pick ticket and starts bulk pick tour
108
Place bulk pick ticket in tote
110
Transfer totes to bulk pack station for packing

Fig. 6

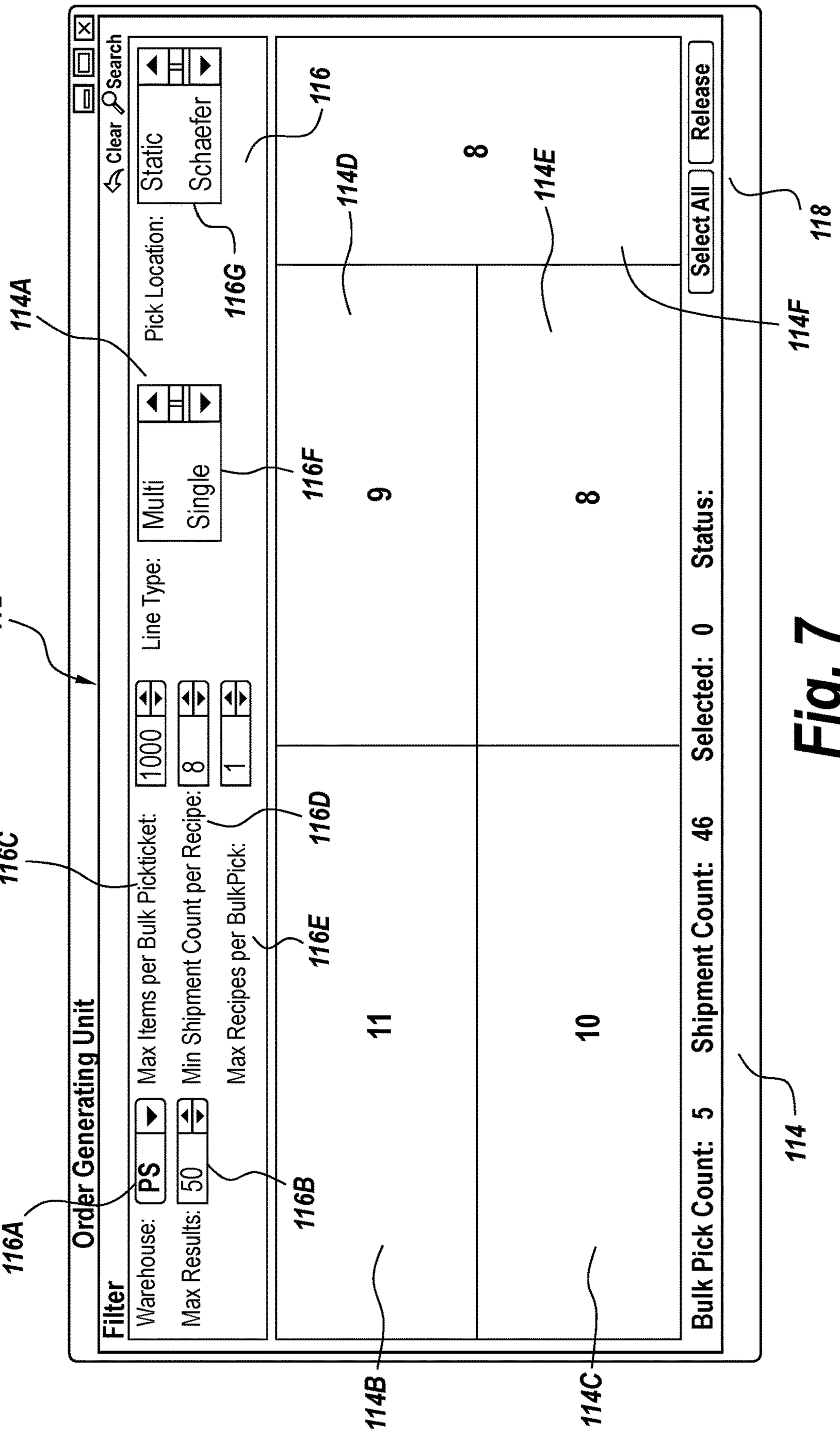

Order Generating Unit
Filter
Warehouse: PS
Max Results: 50
Max Items per Bulk Pickticket: 1000
Min Shipment Count per Recipe: 8
Max Recipes per BulkPick: 1
Line Type: Multi Single
Clear
Search
Pick Location: Static Schaefer
Select All
Release
Bulk Pick Count: 5
Shipment Count: 46
Selected: 0
Status:
11
10
9
8
114
114A
114B
114C
114D
114E
114F
116
116A
116B
116C
116D
116E
116F
116G
118
112

Fig. 7

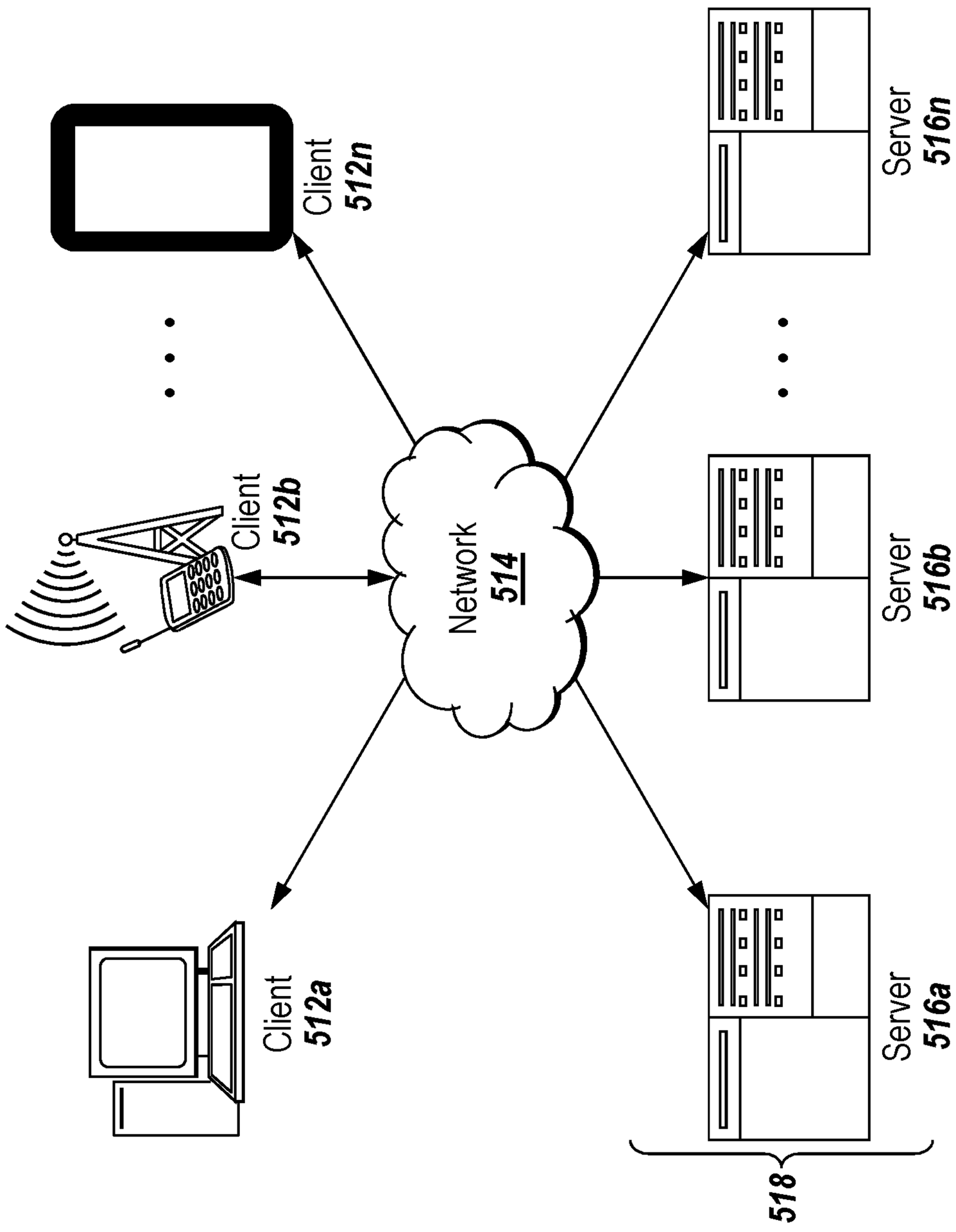

Client
512n
Client
512b
Client
512a
Network
514
Server
516n
Server
516b
Server
516a
518

Fig. 8

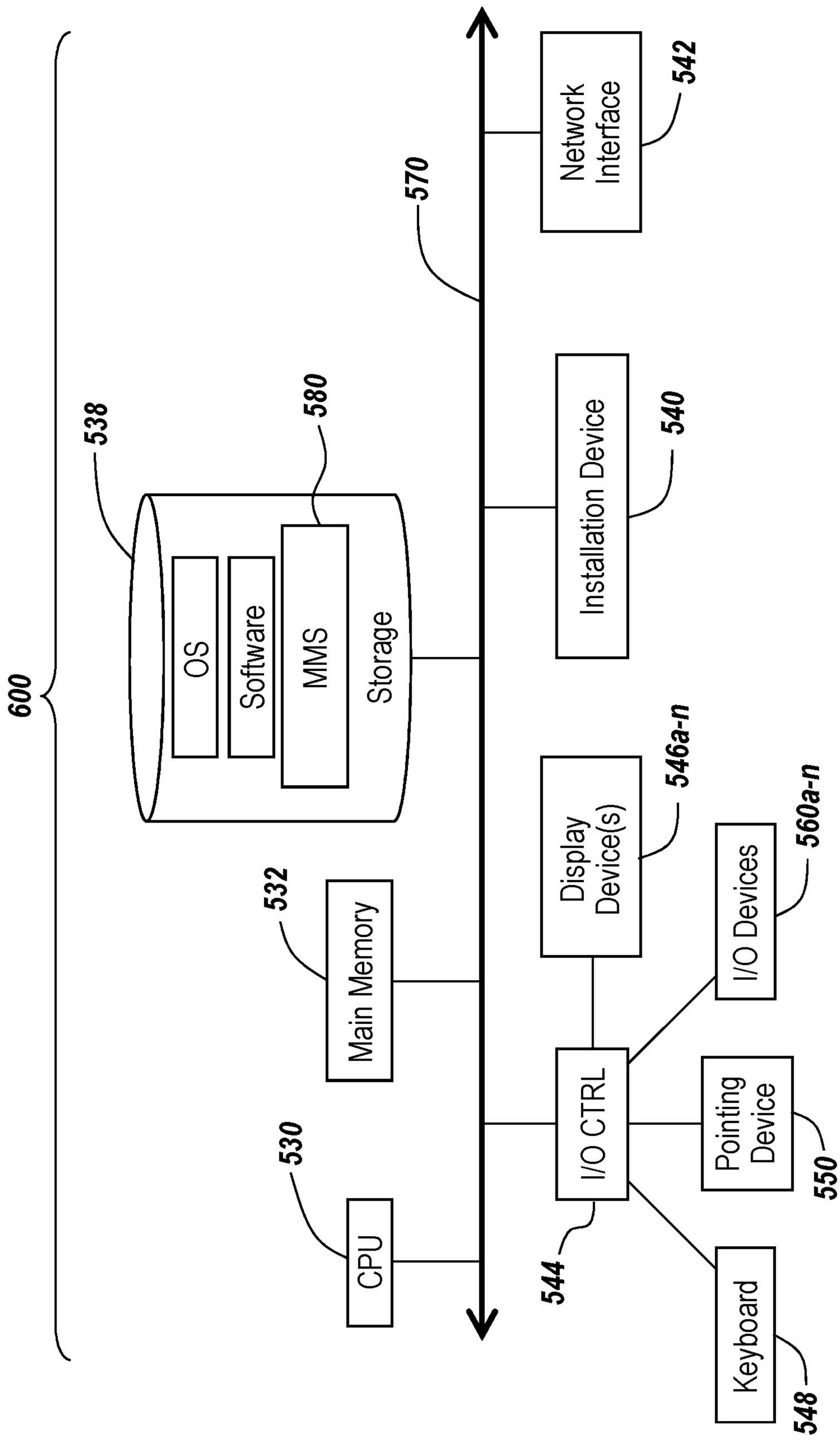

600
570
Network Interface
542
538
580
OS
Software
MMS
Storage
Installation Device
540
532
Main Memory
Display Device(s)
546a-n
I/O Devices
560a-n
530
CPU
I/O CTRL
Pointing Device
550
544
Keyboard
548

Fig. 9

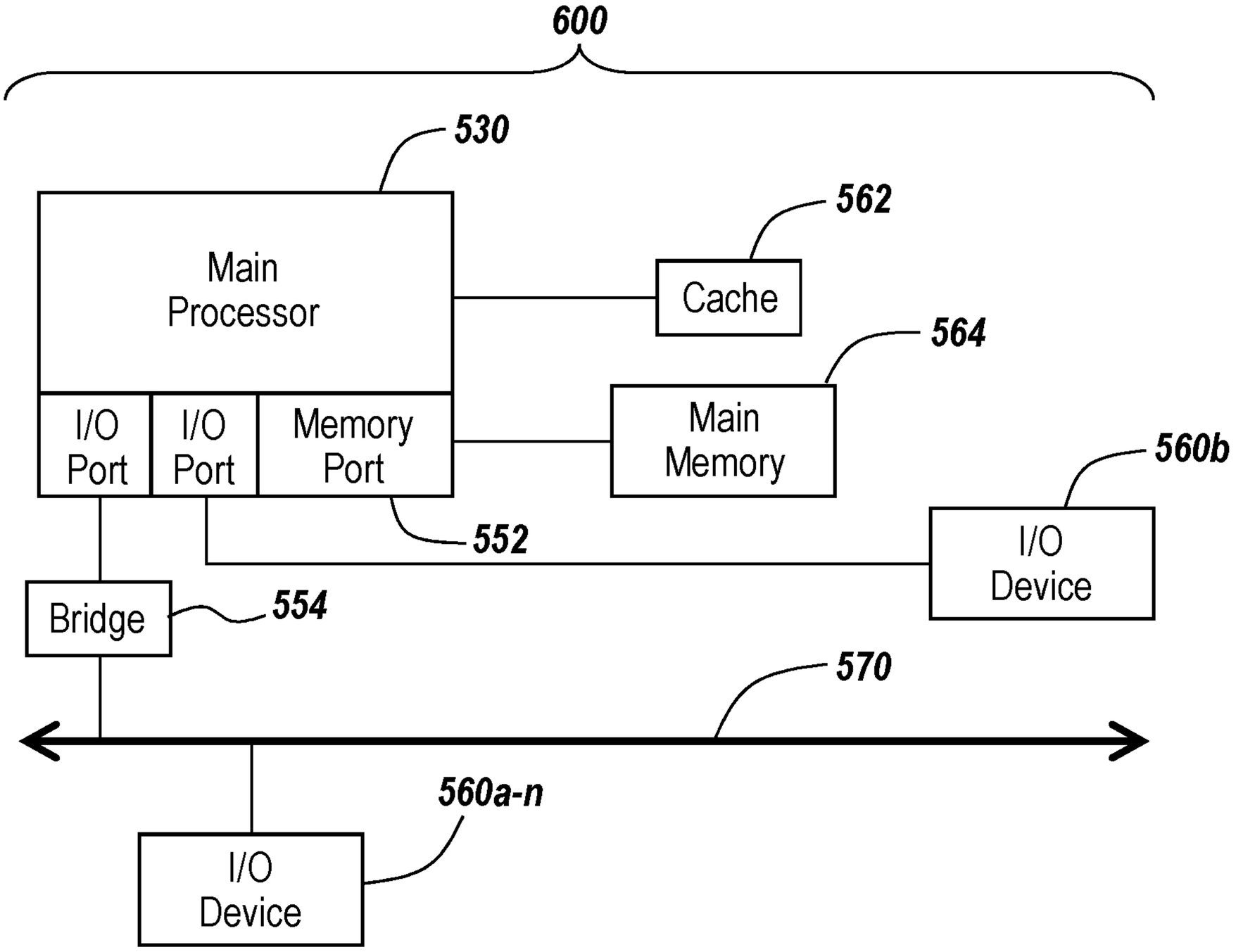

600
530
Main Processor
562
Cache
564
Main Memory
I/O Port
I/O Port
Memory Port
552
560b
I/O Device
Bridge
554
570
560a-n
I/O Device

Fig. 10

SYSTEM AND METHOD FOR PERFORMING BULK PICK OF ITEMS OF A CUSTOMER ORDER

RELATED APPLICATION

The present application claims priority to provisional patent application Ser. No. 62/700,619, filed on Jul. 19, 2018, and entitled SYSTEM AND METHOD FOR PERFORMING BULK PICK OF ITEMS OF A CUSTOMER ORDER, the contents of which are herein incorporated by reference.

BACKGROUND OF THE INVENTION

Vendors, particularly in home shopping industries involving telephone ordering, mail ordering, or e-commerce, often need to fulfill and package customer orders to be shipped to customers. The customer order may include one or more product items, as well as promotional literature. In some circumstances, product fulfillment and packaging may be done manually with a worker picking items corresponding to the customer order from a fulfillment center or warehouse and then inserting orders into packages. In order to increase efficiency over conventional manual picking and packaging techniques, automated picking stations and packing machines have been introduced. However, such picking processes are designed to have a person simply pick an item from a selected location and then transfer the item to a packing station for packaging, without regard to optimizing the pick route or picking and packaging process.

Further, conventional item picking and packaging systems require large capital investments, and still are not fully adapted to optimize the item picking and packaging process.

SUMMARY OF THE INVENTION

The present invention is directed to an order fulfillment system that receives and processes customer orders, and then determines whether the specific items in the collected customer orders warrant the creation and execution of bulk pick. If the system determines that a series of bulk picks (e.g., bulk pick wave) are required, then the system generates a series of bulk pick recipes that include a selected collection of items to be picked, generates a bulk pick ticket associated with each bulk pick, and then the picks are sent to a pick agent or to an automated system.

According to one embodiment, the present invention is directed to a customer order fulfillment system comprising an order collection unit for collecting information associated with a plurality of customer orders from a plurality of customers and generating customer order data that includes data associated with each of the plurality of customer orders and the plurality of customers, wherein each of the plurality of customer order includes one or more items associated therewith. The system also includes an order generating unit for receiving the customer order data from the order collection unit and generating in response thereto consolidated order fulfillment data, and a bulk pick order fulfillment unit for receiving the consolidated order fulfillment data from the order generating unit and grouping together similar ones of the items associated with the plurality of customer orders to form a plurality of bulk picks, wherein one or more of the plurality of bulk picks can form part of one or more bulk pick tours. The system further includes a pick tour generating unit for receiving the consolidated order fulfillment data from the order generating unit and for generating pick tour instructions associated with a pick tour from the consolidated order fulfillment data.

According to the system of the present invention, the bulk pick order fulfillment unit groups the items in the consolidated order fulfillment data into shipments according to one or more predetermined logical parameters. Further, the bulk pick order fulfillment unit includes processing hardware that is configured to: map the one or more items in each of the plurality of customer orders to product identification data; generate one or more bulk picks having associated therewith one or more bulk pick recipes from the data associated with the customer orders, wherein each of the bulk pick recipes includes a selected quantity of the one or more items from the plurality of customer orders and a selected quantity of one or more additional items; and generate a bulk pick ticket associated with each of the bulk picks.

According to the present invention, the bulk pick ticket includes information about the one or more items in the bulk pick recipe, and location information associated with the location of the one or more items in the warehouse.

According to other aspects of the present invention, the bulk pick order fulfillment unit generates a connected graph of groupings of the items from the customer orders and the one or more additional items, wherein the items from the customer orders and the additional items form nodes of the connected graph.

According to still other aspects, the order generating unit generates a tree map for visually displaying on a display device selected consolidated order fulfillment data. The tree map comprises a plurality of configurable and selectable parameters for allowing a user to select parameters associated with the customer orders, and wherein the selectable parameters include one or more of: a selected warehouse, the maximum number of items per bulk pick ticket, the minimum shipment count per bulk pick recipe, or the maximum number of recipes per bulk pick.

The customer order fulfillment system of the present invention further comprises an automated fulfillment sub-system for automatically retrieving the items that form the bulk pick or that form the pick tour, and/or a packing and shipping sub-system for packing and shipping the items from the customer orders. The system can also employ a controller for scheduling one or more selected time periods for performing the bulk pick tours.

According to another practice, the present invention is directed to a computer-implemented method comprising collecting information associated with a plurality of customer orders from a plurality of customers and generating customer order data that includes data associated with each of the plurality of customer orders and the plurality of customers, wherein each of the plurality of customer order includes one or more items associated therewith; generating in response to the customer order data consolidated order fulfillment data; grouping together similar ones of the items associated with the plurality of customer orders to form a plurality of bulk picks, wherein one or more of the plurality of bulk picks can form part of one or more bulk pick tours; and generating pick tour instructions associated with a pick tour from the consolidated order fulfillment data.

The computer-implemented method further comprises grouping the items in the consolidated order fulfillment data into shipments according to one or more predetermined logical parameters.

According to another practice, the computer-implemented method of the present invention includes mapping customer items in the customer orders to product identification data; generating one or more bulk picks having one or more bulk

pick recipes from the data associated with the customer orders, wherein each of the bulk pick recipes includes a selected quantity of one or more items from the customer orders and a selected quantity of one or more additional items; and generating a bulk pick ticket associated with each of the bulk picks. The bulk pick tickets includes information about the one or more items in the bulk pick recipe, and data associated with the location of the one or more items in the warehouse.

The computer-implemented method can also include generating a connected graph of groupings of the items from the customer orders and the one or more additional items, wherein the items from the customer orders and the additional items form nodes of the connected graph, and/or generating a tree map for visually displaying on a display device selected consolidated order fulfillment data. The tree map includes a plurality of configurable and selectable parameters for allowing a user to select parameters associated with the customer orders, and wherein the selectable parameters include one or more of: a selected warehouse, the maximum number of items per bulk pick ticket, the minimum shipment count per bulk pick recipe, or the maximum number of recipes per bulk pick.

According to still another practice, the present invention is directed to a computer-implemented method comprising collecting information associated with a plurality of customer orders from a plurality of customers and generating customer order data that includes data associated with each of the plurality of customer orders and the plurality of customers, wherein each of the plurality of customer order includes one or more items associated therewith; grouping together similar ones of the items associated with the plurality of customer orders to form a plurality of bulk picks, wherein one or more of the plurality of bulk picks can form part of one or more bulk pick tours, and wherein the one or more bulk picks includes one or more bulk pick recipes, wherein each of the bulk pick recipes includes a selected quantity of one or more items from the customer orders and a selected quantity of one or more additional items; and generating a bulk pick ticket associated with each of the bulk picks.

BRIEF DESCRIPTION OF DRAWINGS

These and other features and advantages of the present invention will be more fully understood by reference to the following detailed description in conjunction with the attached drawings in which like reference numerals refer to like elements throughout the different views. The drawings illustrate principals of the invention and, although not to scale, show relative dimensions.

FIG. **1** is a schematic block diagram of the order fulfillment system of the present invention.

FIG. **2** is a schematic flowchart diagram illustrating the steps for generating a bulk pick recipe according to the teachings of the present invention.

FIG. **3** is a connected tree map diagram for determining the relationship between various items in various customer orders according to the teachings of the present invention.

FIG. **4** is a depiction of the bulk picks and corresponding bulk pick recipes according to the teachings of the present invention.

FIG. **5** is a schematic block diagram of a bulk pick ticket generated by the order fulfillment system of the present invention.

FIG. **6** is a schematic flow chart diagram illustrating the steps involved with generating a bulk pick ticket and associated bulk pick tour according to the teachings of the present invention.

FIG. **7** is a tree map that operates as a visual representation of the relative amount of work that can potentially be fulfilled via a bulk pick order via a set of configurable operating parameters according to the teachings of the present invention.

FIG. **8** is a schematic block diagram depicting an embodiment of a network environment comprising client devices in communication with servers through a network arrangement.

FIGS. **9** and **10** are schematic block diagrams depicting embodiments of computing devices useful for the methods and systems described herein.

DETAILED DESCRIPTION

Exemplary embodiments of the present invention address these and other problems associated with the picking of items corresponding to a customer order by employing an order fulfillment system for picking the items and then packaging and shipping the items to the customer.

The present invention is directed to a time based customer ordering and customer order consolidation system suitable for use in an automated or partially automated order fulfillment environment. The customer order can include one or more items that the customer has selected or purchased, and can if desired include additional items, such as warranty information, sales or promotional literature and related brochures, item instructions and the like.

As shown in FIG. **1**, the order fulfillment system **10** of the present invention includes an order collation or collection unit **12** for collecting or collating customer orders as they are entered into the system. As is known in the art, the customer orders can be introduced or entered into the system either through the Internet via a website ordering operation or can be entered into the system by a customer service representative while accepting order instructions directly from the customer, such as over a telephone. The customer order collection unit **12** can generate customer and order information or data that is transmitted and received by an order generating unit **14**. The order collection unit **12** consolidates the incoming customer orders and organizes and consolidates selected order and customer information from the customer orders, including for example the customer ID, the shipment address, type of shipment, number of items in the customer order, and the like. The order generating unit **14** is configured for controlling and managing the order data for fulfillment at a fulfillment facility or warehouse in a time based manner. The order data is preferably organized and managed by the order generating unit **14** so as to optimize the selection (e.g., picking) of the items in the customer order and then shipping the items to the customer in an expeditious manner.

The order generating unit **14** can be monitored by a separate computing system and/or a warehouse supervisor via the computing system to determine the order fulfillment actions that need to be taken. The order generating unit **14** is adapted or configured to prepare a set of order fulfillment instructions or data for fulfilling the incoming customer orders in a time based manner. The fulfillment order instructions can be based on a set of logical rules and ordering priorities for releasing one or more customer orders to be fulfilled by the order fulfillment system **10**.

The consolidated order fulfillment instructions or data generated by the order generating unit **14** can be transmitted to an automated fulfillment system **16**, such as an automated product picking system. An example of a suitable automated product picking system suitable for use with the present invention includes the systems manufactured and sold by SSI Schaefer, Germany. As is known in the art, the automated fulfillment system **16** can include a series of vertical towers or stacks that include a number of distinct receptacles for storing one or more items. The stacks can be stationary or adapted to rotate about a central longitudinal axis. The stacks can be coupled to one or more movable retrieval arms or mechanisms that are adapted to move vertically along the stacks and if desired between the stacks. The items or products retrieved by the movable arms can be placed in one or more totes or bins, which in turn can be moved or conveyed along a conveyance system. The conveyance system can include tracks with rollers and the like. The automated fulfillment system **16** can be controlled or operated by a central or a dedicated computing system.

Alternatively, the order generating unit **14** can transmit the order fulfillment instructions to a bulk pick order fulfillment unit **18**. For example, according to one practice, the order generating unit **14** can be configured to group together a set of customer orders that share similar features, items or traits, into a larger bulk pick order, and the bulk pick order data can be transmitted to the bulk pick order fulfillment unit **18**. Alternatively, the bulk pick order fulfillment unit **18** can generate the bulk pick data. The bulk pick orders (e.g., a bulk pick order wave) are groupings of customer orders that may be picked or fulfilled in a warehouse in aggregate as opposed to fulfilling each customer order independently. As such, warehouse data that includes the configuration of the warehouse, which can include rows of storage racks with associated storage bins, and data associated with specific items located in specific bins at specific warehouse locations, can be stored in the database **24** and is accessible by the order generating unit **14**, the bulk pick order fulfillment unit **18** and the pick tour generating unit. The bulk pick orders forming the bulk pick wave are selected so as to optimize the fulfillment process by selecting orders that have certain features, items or traits in common. The bulk pick order fulfillment unit **18** can generate data associated with a bulk pick that can form part of a bulk pick tour or wave, and which can be fulfilled by the automated product picking system **16**, by one or more mobile operators or pick agents that manual pick one or more items corresponding to the bulk pick tour, or by both. As used herein, the term "bulk pick," "bulk pick tour," or "bulk pick wave," is intended to mean a plurality of similar or identical items that are grouped or bulked together and which can be selected based on the warehouse data from a selected warehouse location. The bulk picks or grouped items when assigned to the automated fulfillment system or to a pick tour agent for retrieval form the bulk pick tours. The bulk picks or bulk pick tours can then be assigned to the pick agents or to the automated fulfillment unit in series to form a bulk pick wave.

Additionally or alternatively, the order generating unit **14** can interface with a pick tour generating unit **20**, which receives the order fulfillment instructions from the order generating unit **14**. The pick tour generating unit **20** can generate pick tour instructions for a single item or a multi-item order. The pick tour instructions can be forwarded to the automated product picking system and/or to a pick tour mobile operator for performing a pick tour. The pick tour generating unit **20** generates pick tour instructions based on the consolidated customer order information received from the order generating unit **14**. The pick tour instructions leverage the similarity in customer orders and item locations within the warehouse so as to minimize the amount of time it takes to pick the one or more items that comprise the customer order. The pick tour instructions can generate or be converted into a pick tour that can be assigned to pick agents or mobile operators. The pick agents can utilize a mobile cart that has selected compartments associated therewith to manually pick or select the items that correspond to the customer order from the warehouse. The pick agent can employ a handheld scanning device, such as for example the conventional handheld scanners sold by Intermec, that can guide the pick agent to the selected location of the item and assist the pick agent in selecting the correct item. The handheld device also serves to allow the order fulfillment system **10** to track and verify the location of the pick agent, and to perform product and location verification in real time. As used herein, the term "pick tour" is intended to mean a series of instruction that include one or more pick tasks that when aggregated or consolidated together form a tour. The tour is in essence a series of instructions sent to the pick agent to pick, select or retrieve one or more items associated with one or more customer orders from selected locations within the warehouse. Alternatively, the pick tour can be performed by the automated fulfillment system **16**, which receives the aggregated list of items (or tour) from the pick tour generating unit and retrieves the items from selected locations within the automated fulfillment system.

Once the customer order has been picked and fully assembled, the contents of the order can be assembled into totes or compartments of totes, which are then placed on a conveyor belt and sent to a packing and shipping subsystem **22**. A packaging and shipping subsystem suitable for use with the present invention includes the packing station disclosed in U.S. Publ. No. 2014/0360141, to the assignee hereof, the contents of which are herein incorporated by reference. In transit, the order fulfillment system **10** can also include structure for automatically printing a customer invoice and/or packing slips for insertion within the corresponding compartment within the tote. The illustrated packing and shipping subsystem **22** receives the totes and packages the contents of each compartment of the tote for shipping to the customer.

As shown, the illustrated order fulfillment system **10** can also include a general database **24** for storing information concerning the customer orders as well as selected information corresponding to each of the illustrated units and subsystems. Specifically, the database **24** can store customer information, including customer name, address, financial payment details, order history and the like. The database **24** can also store information regarding the items that are stored in the warehouse as well as the warehouse information. The item information can include details of each item, including item type, description, price, quantity and the like. The database can also be configured to store information regarding the programs and associated segments or plays that are broadcast, as well as the sequence of items that are displayed and discussed during the program.

The order generating unit **14** of the present invention is configured to collect data associated with the customer orders and prepare a set of order fulfillment instructions for fulfilling the incoming customer orders in a time based manner. The order fulfillment instructions can be based on a set of logical rules and ordering priorities for releasing one or more customer orders to be fulfilled by the order fulfillment system **10**. The order generating unit **14**, based on the

number of customer orders, and the overlap or similarity between the items in the orders, can send instructions to the bulk pick order fulfillment unit **18** to execute a bulk pick of selected items. The order generating unit **14** or the bulk pick order fulfillment unit **18** can schedule the bulk pick at a time of day that is convenient based on the total number of customer orders being handled, the time of day, the number of pick agents assigned to the warehouse floor, and the like.

The order generating unit **14** can generate a color coded or non-color coded tree map that can be displayed to the supervisors on a suitable display device as a visual representation of the relative amount of work that can potentially be fulfilled via a bulk pick order by the bulk pick order fulfillment unit **18** under a set of configurable operating parameters. An example of such a tree map is shown in FIG. **7**. As shown, the order fulfilment system **10** can generate content that is displayed on a window or interface on a display device. The illustrated window **112** can include one or more panes **114** to display selected content associated with the customer orders and to enable or allow a user to customize via selectable parameters the metric associated with a bulk pick or wave. The panes **114** can include pane **114**A that is positioned in an upper portion or region of the window **112** and which displays a set of user selectable parameters **116**. The parameters **116** can include the selected warehouse **116**A, the maximum number of results **116**B to be considered by the bulk pick order fulfillment unit **18**, the maximum and minimum number of different multi-item combinations (e.g., recipes) **116**C to generate per bulk pick, the maximum recipes per bulk pick **116**E, the line type **116**F which includes whether a single item, mult-item, or both single item and multi-item orders should be included in the tree map and the pick location **116**G (e.g., static (non-automated) or automated fulfillment system). The order generating unit **14** can then generate a map of the bulk wave for visual display to the user. The flexibility of these parameters enables the supervisor to adapt the amount and types of work they have pending in the order collection unit **12** to the available pick agents and availability of other system equipment, including the automated fulfillment system **16**. The foregoing features or parameters can be presented to the supervisor in any suitable format, and can preferably be displayed in a dashboard format via the pane elements **114**. The order generating unit **14** can release order information to the bulk pick order fulfillment unit **18** to generate bulk picks and to the pick tour generating unit **20** to generate mobile pick tours for the pick agents. The order generating unit **14** via the window **112** can display the map that can be illustrated as a set of pane elements **114**A-**114**F. Each of the respective panel elements **114**A-**114**F contains the total number of customer orders that are included in the bulk pick. Larger numbers are contained in larger rectangles in the tree map and are ordered such that the larger total order counts are placed in a top-to-bottom left-to-right ordered by size. In addition to the size of the rectangle indicating the relative number of orders, the color of the rectangle may be used as a visual indicator of the estimated size or effort (e.g., red indicating a large number of orders, and blue representing a lower number of orders). This coloring technique offers a visual heat map of the orders that can be generated into bulk picks allowing a user to rapidly visually inspect the number of orders and estimate the effort involved to fulfill the respective bulk picks when released. The window **112** also displays on a bottom portion thereof parameter values selected by the user, including the bulk pick count, shipment count, as well as action buttons **118** that allow the user to select the illustrated parameters or to release the bulk wave to the system **10**. As used herein, a pane element can be a user interface or portion thereof, such as a screen, a space, a surface, or the like.

The bulk pick order fulfillment unit **18** employs processing hardware for implementing heuristics and rule based schedules that determine the optimal way to group items in the customer orders into shipments. The logical parameters include consideration of the payment status of the customer or of the customer orders, destination addresses, and services such as sizing and appraisals that may have been applied to the items of the customer order. The bulk pick order fulfillment unit **18** also considers the shipping option selected by the customer and the guaranteed or estimated shipping dates that were communicated to the customer, as well as other factors, including grouping of items based on specific product brand, sales of items, and different sales channels.

Consolidating customer orders into shipments using the foregoing time-based process has multiple benefits and advantages. One advantage is that the process reduces the amount of shipment packaging materials needed, reduces the number of promotional inserts needed, and reduces the overall postage cost of shipping the packages. Additionally, customers may be incentivized to purchase additional items by reduced shipping and handling rates for additional items purchased within a selected time period, such as for example a twenty four hour time period.

FIG. **2** is a schematic flow chart diagram that illustrates the process or method that the bulk pick order fulfillment unit **18** employs to generate one or more bulk picks or bulk pick recipes from the consolidated order fulfillment data received from the order generating unit **14**. The bulk pick order fulfillment unit **18** includes processing hardware, such as a processor or a controller, that is configured to initially map items in the customer order to product identification (ID) data and selected quantities of product, step **30**. For example, as shown in FIG. **3**, the illustrated bulk pick order fulfillment unit **18** generates a connected graph **26** of groupings of customer orders and corresponding items, and then devolves the customer orders into constituent items and corresponding inserts such as informational, warranty, and marketing materials, and places them on the connected graph as nodes. As shown, and according to a simple example, the items that form part of this potential bulk group of customer orders include three different product items designated as ABC123, DEF456, and DQK928 that were purchased by customers and formed part of the customer order data. In addition to the customer items, the example assumes that the orders also include a new customer card designated as NEW CUST and a warranty card. The number of purchased items that overlap and require warranty and new customer cards are illustrated by the connecting lines with corresponding amounts or numbers. Specifically, the number of customers that purchased selected items and require a warranty or new customer card are shown in the intermediate number boxes. As shown, one hundred (100) customers purchased all three items and require a warranty card and a new customer card; one hundred fifty (150) customers only purchased the item DQK928; only fourty (40) customers purchased item DEF456; fourty (40) customers purchased all three items and are not receiving any inserts, and so forth. Other item amounts are also shown.

The bulk pick order fulfillment unit **18** can also generate one or more bulk pick recipes from the data associated with the connected graph, step **32**. As used herein, the term "recipe" or "bulk pick recipe" is intended to mean a collection of a selected items from the customer orders and the

additional items that are correlated or grouped together. As shown in FIG. **4**, a user such as the supervisor can select various parameters or features **58** of the bulk pick in the bulk pick order fulfillment unit **18**. For example, a user or the system **10** can define the maximum number of recipes per bulk pick, the maximum item count per bulk pick, and the minimum bulk group item count. Once the user has selected these parameters, the resulting calculated values for the bulk pick are presented including the total number of ingredients (i.e. items), the total number of recipes, and the total number of bulk picks that are generated. As shown, the bulk pick order fulfillment unit **18** generates and constructs bulk picks **42**, **44**, and **46**, where each bulk pick comprises a selected number of bulk pick recipes or bulk groups. The bulk pick order fulfillment unit **18** can determine the bulk pick group or recipe sequence by determining the largest or smallest matching product or item count and then determining the largest or smallest number of inserts. The system can thus organize and aggregate the data in ascending or descending order relative to the number of items in the bulk pick. Those of ordinary skill in the art will readily recognize that the item data from the connected graph **26** can be organized in other ways as well. As illustrated, bulk pick **42** includes bulk pick recipes **52**, **54** and **56**; bulk pick **44** includes recipes **60** and **62**; and bulk pick **46** includes recipes **66** and **68**. Each of the above recipes includes one or more ingredients or items. For example, recipe **52** includes five ingredients, including items DQK928, ABC123, and DEF456, as well as the new customer insert NEW CUST and the warranty insert. Recipe **54** includes items DQK928, ABC123, and DEF456 with no additional inserts, and recipe **56** includes, for ingredients, items ABC123 and DEF456 and the new customer insert NEW CUST. Once the maximum number of recipes for each of the bulk picks is reached, the bulk pick order fulfillment unit **18** creates a further bulk pick. The bulk pick order fulfillment unit **18** can also generate less than the maximum number of bulk pick recipes, such as those associated with the bulk picks **44** and **46**. The bulk pick order fulfillment unit **18** generates and organizes the bulk picks so that the most difficult recipes are collated first into the first bulk pick. For example, as shown in FIG. **4**, the bulk pick **42** includes recipes **52**, **54**, **56** that are more complicated than the recipes in the other bulk picks **44** and **46**.

When the bulk pick order fulfillment unit **18** generates one or more bulk pick recipes that include ingredients (or the recipe itself) outside of one or more of the predetermined parameters, the unit **18** does not generate a bulk pick employing these recipes. The bulk picks and corresponding bulk pick recipes can be utilized by the system **10**, such as by the pick tour generating unit **20** or the automated fulfillment system **16** so that the ingredients within the recipe are selected either by pick agents via a mobile tour or by the automated system. Further, the bulk pick order fulfillment unit **18** partitions or separates the bulk picks from each other according to the bulk pick group count parameter and the maximum item count per bulk pick parameter.

The bulk pick order fulfillment unit **18** then generates a bulk pick sheet or ticket that corresponds to each of the bulk picks **42**, **44**, **46**, step **34**. The bulk pick ticket is sent to either a mobile pick agent and/or to the automated fulfillment system **16** to retrieve the items, step **36**. If the bulk pick ticket is sent to the automated system **16**, processing hardware and corresponding software associated with the system **10** or the automated system **16** can perform the retrieval of the items based on the information contained within the bulk pick ticket. FIG. **5** is an example of a bulk pick ticket **80** generated by the bulk pick order fulfillment unit **18** according to the teachings of the present invention. The bulk pick ticket **80** can be printed by any suitable printing device associated with or coupled to the bulk pick order fulfillment unit **18** or the bulk pick ticket can be transmitted to other portions of the system **10** via processing hardware. The illustrated bulk pick ticket **80** can include any selected type and arrangement of information, and includes for example a description and image of one or more items, such as the illustrated Item **1** and Item n. The first listed item in the bulk pick ticket **80** is Item **1**, and includes information such as the description and image of the item **82** to be picked from the warehouse, one or more locations of the item **84** in the warehouse, as well as the quantity of the item **86** to be picked. Similarly, Item n includes information such as the description and image of the item **92** to be picked from the warehouse, a location of the item **94** in the warehouse, as well as the quantity of the item **96** to be picked. The bulk pick order fulfillment unit **18** can print one or more of the bulk pick tickets **80** for use by the system and by, for example, a pick agent. A bar code **88** can also be associated with the bulk pick ticket **80** so that the pick agent and subsequent handlers of the items can determine the customer orders associated with the items.

The items identified by the bulk pick process of the bulk pick order fulfillment unit **18** and as set forth in the bulk pick ticket **80** can be picked according to the following process. One of ordinary skill in the art will readily recognize that the process can include additional steps or can omit one or more of the following steps without departing from the spirit and scope of the present invention.

As shown in FIG. **6**, the order fulfillment system **10** of the present invention collates and collects the customer order information with the order collection unit **12**, and conveys this information to the order generating unit **14**. The order generating unit **14** visually displays the order data through a display device to a warehouse supervisor, who sets or selects certain bulk wave parameters. For example, the system **10** can generate the tree map shown in FIG. **7** for use by the supervisor. The order generating unit **14** also receives other related information, such as additional customer information, order status information, and other system related information, from the database **24**. The order generating unit **14** then transmits consolidated order fulfillment information to the bulk order fulfillment unit **18**. The bulk order fulfillment unit **18** generates the bulk picks, step **102**. The bulk pick and related customer order and item information is sent to a print device to print the bulk pick ticket **80**, step **104**. The bulk pick ticket **80** is received by a pick agent in the warehouse who creates or employs a bulk pick cart for temporarily storing the items associated with the bulk pick. The pick agent then starts a bulk pick tour, step **106**. The pick agent moves along a path in the warehouse that is optionally optimized by the system **10** to retrieve or pick the items at selected locations. The selected items are then placed in selected compartments within each tote that is stored on the cart, or kept separated in containers or bags. The bulk pick ticket is then associated with one or more of the totes, step **108**. Specifically, the bulk pick ticket can be placed on one of the totes, typically the tote on top when stacked, or is affixed to the cart in cases of very large bulk picks. The cart and associated totes are then moved to a selected area in the warehouse, and the totes are moved from the cart to a temporary holding station, and are then transferred by any suitable mechanism, including a conveyor belt system, to a bulk packing station, step **110**. A bulk pack agent associated with the bulk pack station then scans the bulk pick ticket **80** to determine if the recipes of the bulk

pick are complete. If not, then the agent keeps assembling customer orders according to the bulk pick recipe until the recipe is complete. If more than one recipe is included in the bulk pick, then the next unfinished recipe is loaded for continued processing. The items are then packed and shipped to the customer according to known techniques.

The bulk picking of items in customer orders by the bulk pick order fulfillment unit **18** offers additional benefits and advantages. For example, a bulk pick is more efficient than a shipment pick performed by pick agents in situations where there are many customers that ordered the same set of items. This is because the pick agent only needs to visit a location once per item, and can pick multiple ones of the same item at the same time. Although the pick agent can employ a mobile cart for picking multiple single item shipments, or multiple multi-item shipments on a cart while performing non-bulk picks, a barcode scan is required on each item and tote compartment to perform an association to ensure item movement tracking accuracy. The bulk pick process can handle much larger quantities or items per pick, and does not require a barcode scan.

By way of example, consider a situation where one hundred customers ordered the same item. A pick agent can be directed to pick one hundred of the same item from a stock location and then take the entire group to a bulk processing station where the weight of the item and inserts is acquired once, customer invoices are printed, and then the agent assembles the individual shipments like stuffing envelopes. In addition to single item bulk picks, the system **10** supports multi-item picks and also takes into account any promotional, product oriented, or customer oriented inserts such that each of the recipes is unique. An example of a multi-item bulk is an ensemble scenario where one hundred customers ordered a ring, and fifty of those customers also ordered the matching bracelet, and another twenty five customers ordered just the bracelet. This would yield a bulk pick with two items: one hundred rings, and seventy five bracelets. This example bulk pick is then assembled into separate customer orders from a total of three recipes: fifty of just the ring, fifty of the ring and bracelet, and twenty-five of just the bracelet. In addition, customer oriented inserts yield more variations of these recipes, but ultimately there is a single pick of just two items that was able to fulfill all of these permutations.

The ability to pick single item shipments and multi-line shipments in parallel via bulk pick reduces the amount of distance and time that it takes to pick the customer shipments. An additional benefit of using the bulk pick process and system is being able to utilize less sophisticated machinery to perform the final packaging step of processing the shipment.

Exemplary Hardware

Following below and referenced above are more detailed descriptions of various concepts and associated hardware of the units of the order fulfillment system **10** of the present invention. It should be appreciated that various concepts introduced above and discussed in greater detail below may be implemented in any number of ways, as the disclosed concepts are not limited to any particular manner of implementation. Examples of specific implementations and applications are provided below primarily for illustrative purposes and for providing or describing the operating environment of the order fulfillment system of the present invention.

Consistent with the foregoing inventive embodiments, it is helpful to describe aspects of the operating environment as well as associated system components (e.g., hardware elements) in connection with the methods and systems described herein. For example, the order fulfillment system **10** of the present invention and associated sub-systems and units, including for example the order collection unit **12**, the order generating unit **14**, the automated fulfillment system **16**, the bulk pick order fulfillment unit **18**, the packing and shipping sub-system **22**, the pick tour generating unit **20**, the database **24**, and any other hardware devices including hand-held scanners and printers, can be coupled together in a network environment. Further, any system unit or combination of units can be consolidated on a single hardware device. For example, as shown in FIG. **8**, a typical network environment can include hardware devices such as one or more clients **512***a*-**512***n* (also generally referred to as local machine(s) **512**, client(s) **512**, client node(s) **512**, client machine(s) **512**, client computer(s) **512**, client device(s) **512**, endpoint(s) **512**, or endpoint node(s) **512**) in communication with one or more servers **516***a*-**516***n* (also generally referred to as server(s) **516**, node **516**, or remote machine(s) **516**) and databases via one or more networks **514**. In some embodiments, a client **512** has the capacity to function as both a client node seeking access to resources provided by a server and as a server providing access to hosted resources for other clients **512***a*-**512***n*. The clients can be any suitable electronic or computing device, including for example, a computer, a server, a smartphone, a smart electronic pad, a portable computer, and the like, such as the computing device **600**. The various units **12**, **14**, **18**, **20** and database **24** of the order fulfillment system **10** of the present invention can be implemented as a client device **512** and/or a server **516**. The sub-systems **16** and **22** of the system **10** can communicate with the remainder of the system **10** via the network **514**. Although FIG. **8** shows a network **514** between the clients **512** and the servers **516**, the clients **512** and the servers **516** may be on the same network **514**. In some embodiments, there are multiple networks **514** between the clients **512** and the servers **516**. In one of these embodiments, a network **514'** (not shown) may be a private network and a network **514** may be a public network. In another of these embodiments, a network **514** may be a private network and a network **514'** a public network. In still another of these embodiments, networks **514** and **514'** may both be private networks.

The network **514** may be connected via wired or wireless links. Wired links may include Digital Subscriber Line (DSL), coaxial cable lines, or optical fiber lines. The wireless links may include BLUETOOTH, Wi-Fi, NFC, RFID Worldwide Interoperability for Microwave Access (WiMAX), an infrared channel or satellite band. The wireless links may also include any cellular network standards used to communicate among mobile devices, including standards that qualify as 1G, 2G, 3G, 4G, or 5G. The network standards may qualify as one or more generations of mobile telecommunication standards by fulfilling a specification or standards such as the specifications maintained by the International Telecommunication Union. The 3G standards, for example, may correspond to the International Mobile Telecommunications-2000 (IMT-2000) specification, and the 4G standards may correspond to the International Mobile Telecommunications Advanced (IMT-Advanced) specification. Examples of cellular network standards include AMPS, GSM, GPRS, UMTS, LTE, LTE Advanced, Mobile WiMAX, and WiMAX-Advanced. Cellular network standards may use various channel access methods e.g. FDMA, TDMA, CDMA, or SDMA. In some embodiments, different types of data may be transmitted via

different links and standards. In other embodiments, the same types of data may be transmitted via different links and standards.

The network **514** may be any type and/or form of network. The geographical scope of the network **514** may vary widely and the network **514** can be a body area network (BAN), a personal area network (PAN), a local-area network (LAN), e.g. Intranet, a metropolitan area network (MAN), a wide area network (WAN), or the Internet. The topology of the network **514** may be of any form and may include, e.g., any of the following: point-to-point, bus, star, ring, mesh, or tree. The network **514** may be an overlay network, which is virtual and sits on top of one or more layers of other networks **514'**. The network **514** may be of any such network topology as known to those ordinarily skilled in the art capable of supporting the operations described herein. The network **514** may utilize different techniques and layers or stacks of protocols, including, e.g., the Ethernet protocol, the internet protocol suite (TCP/IP), the ATM (Asynchronous Transfer Mode) technique, the SONET (Synchronous Optical Networking) protocol, or the SDH (Synchronous Digital Hierarchy) protocol. The TCP/IP internet protocol suite may include application layer, transport layer, internet layer (including, e.g., IPv6), or the link layer. The network **514** may be a type of a broadcast network, a telecommunications network, a data communication network, or a computer network.

In some embodiments, the network system may include multiple, logically-grouped servers **516**. In one of these embodiments, the logical group of servers may be referred to as a server farm **518** or a machine farm **518**. In another of these embodiments, the servers **516** may be geographically dispersed. In other embodiments, a machine farm **518** may be administered as a single entity. In still other embodiments, the machine farm **518** includes a plurality of machine farms **518**. The servers **516** within each machine farm **518** can be heterogeneous, and one or more of the servers **516** or machines **516** can operate according to one type of operating system platform (e.g., WINDOWS NT, manufactured by Microsoft Corp. of Redmond, Wash.), while one or more of the other servers **516** can operate according to another type of operating system platform (e.g., Unix, Linux, or Mac OS X).

In one embodiment, servers **516** in the machine farm **518** may be stored in high-density rack systems, along with associated storage systems, and located in an enterprise data center. In this embodiment, consolidating the servers **516** in this way may improve system manageability, data security, the physical security of the system, and system performance by locating servers **516** and high performance storage systems on localized high performance networks. Centralizing the servers **516** and storage systems and coupling them with advanced system management tools allows more efficient use of server resources.

The servers **516** of each machine farm **518** do not need to be physically proximate to another server **516** in the same machine farm **518**. Thus, the group of servers **516** logically grouped as a machine farm **518** may be interconnected using a wide-area network (WAN) connection or a metropolitan-area network (MAN) connection. For example, a machine farm **518** may include servers **516** physically located in different continents or different regions of a continent, country, state, city, campus, or room. Data transmission speeds between servers **516** in the machine farm **518** can be increased if the servers **516** are connected using a local-area network (LAN) connection or some form of direct connection. Additionally, a heterogeneous machine farm **518** may include one or more servers **516** operating according to a type of operating system, while one or more other servers **516** execute one or more types of hypervisors rather than operating systems. In these embodiments, hypervisors may be used to emulate virtual hardware, partition physical hardware, virtualized physical hardware, and execute virtual machines that provide access to computing environments, allowing multiple operating systems to run concurrently on a host computer. Native hypervisors may run directly on the host computer. Hypervisors may include VMware ESX/ESXi, manufactured by VMWare, Inc., of Palo Alto, Calif.; the Xen hypervisor, an open source product whose development is overseen by Citrix Systems, Inc.; the HYPER-V hypervisors provided by Microsoft or others. Hosted hypervisors may run within an operating system on a second software level. Examples of hosted hypervisors may include VMware Workstation and VIRTUALBOX.

Management of the machine farm **518** may be de-centralized. For example, one or more servers **516** may comprise components, subsystems and modules to support one or more management services for the machine farm **518**. In one of these embodiments, one or more servers **516** provide functionality for management of dynamic data, including techniques for handling failover, data replication, and increasing the robustness of the machine farm **518**. Each server **516** may communicate with a persistent store and, in some embodiments, with a dynamic store.

Server **516** may be a file server, application server, web server, proxy server, appliance, network appliance, gateway, gateway server, virtualization server, deployment server, SSL VPN server, or firewall, or any other suitable computing device, such as computing device **600**. In one embodiment, the server **516** may be referred to as a remote machine or a node. In another embodiment, a plurality of nodes may be in the path between any two communicating servers. The units **12**, **14**, **18** and **20** of the order fulfillment system **10**, FIG. **1**, of the present invention can be stored or implemented on one or more of the servers **516** or clients **512**, and the hardware associated with the server or client, such as the processor or CPU and memory.

The client **512** and server **516** may be deployed as and/or executed on any type and form of computing device, such as for example a computer, network device or appliance capable of communicating on any type and form of network and performing the operations described herein. FIGS. **9** and **10** depict block diagrams of a computing device **600** useful for practicing an embodiment of the client **512** and/or a server **516**, and thus by extension any unit or combination of units **12**, **14**, **18** and **20** of the order fulfillment system **10** of the present invention. As shown in FIGS. **9** and **10**, each computing device **600** includes a central processing unit **530**, and a main memory unit **532**. As shown in FIG. **9**, a computing device **600** may include a storage device **538**, an installation device **540**, a network interface **542**, an I/O controller **544**, display devices **546***a*-**546***n*, a keyboard **548** and a pointing device **550**, e.g. a mouse. The storage device **538** may include, without limitation, an operating system, and/or software. As shown in FIG. **10**, each computing device **600** may also include additional optional elements, e.g. a memory port **552**, a bridge **554**, one or more input/output devices **560***a*-**560***n* (generally referred to using reference numeral **560**), and a cache memory **562** in communication with the central processing unit **530**.

The central processing unit **530** is any logic circuitry that responds to and processes instructions fetched from the main memory unit **564**. In many embodiments, the central processing unit **530** is provided by a microprocessor unit, e.g.:

those manufactured by Intel Corporation of Mountain View, Calif.; those manufactured by Motorola Corporation of Schaumburg, Ill.; the ARM processor and TEGRA system on a chip (SoC) manufactured by Nvidia of Santa Clara, Calif.; the POWER7 processor, those manufactured by International Business Machines of White Plains, N.Y.; or those manufactured by Advanced Micro Devices of Sunnyvale, Calif. The computing device **600** may be based on any of these processors, or any other processor capable of operating as described herein. The central processing unit **530** may utilize instruction level parallelism, thread level parallelism, different levels of cache, and multi-core processors. A multi-core processor may include two or more processing units on a single computing component. Examples of multi-core processors include the AMD PHENOM IIX2, INTEL CORE i5 and INTEL CORE i7.

Main memory unit or main memory storage unit **564** may include one or more memory chips capable of storing data and allowing any storage location to be directly accessed by the processor **530**. The main memory unit **564** may be volatile and faster than memory of the storage unit **538**. Main memory units **564** may be Dynamic random access memory (DRAM) or any variants, including static random access memory (SRAM), Burst SRAM or SynchBurst SRAM (BSRAM), Fast Page Mode DRAM (FPM DRAM), Enhanced DRAM (EDRAM), Extended Data Output RAM (EDO RAM), Extended Data Output DRAM (EDO DRAM), Burst Extended Data Output DRAM (BEDO DRAM), Single Data Rate Synchronous DRAM (SDR SDRAM), Double Data Rate SDRAM (DDR SDRAM), Direct Rambus DRAM (DRDRAM), or Extreme Data Rate DRAM (XDR DRAM). In some embodiments, the main memory **564** or the storage **538** may be non-volatile, e.g., non-volatile read access memory (NVRAM), flash memory non-volatile static RAM (nvSRAM), Ferroelectric RAM (FeRAM), Magnetoresistive RAM (MRAM), Phase-change memory (PRAM), conductive-bridging RAM (CBRAM), Silicon-Oxide-Nitride-Oxide-Silicon (SONOS), Resistive RAM (RRAM), Racetrack, Nano-RAM (NRAM), or Millipede memory. The main memory **564** may be based on any of the above described memory chips, or any other available memory chips capable of operating as described herein. In the embodiment shown in FIG. **9**, the processor **530** communicates with main memory **532** via a system bus **570** (described in more detail below). FIG. **10** depicts an embodiment of a computing device **600** in which the processor communicates directly with main memory **564** via a memory port **552**. For example, in FIG. **10** the main memory **564** may be DRDRAM. The computer executable instructions of the present invention may be provided using any computer-readable media that is accessible by the computing or electronic device **600**. Computer-readable media may include, for example, the computer memory or storage unit **564**, **538** described above. The computer storage media may also include, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other non-transmission medium that can be used to store information for access by a computing device. In contrast, communication media may embody computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave, or other transport mechanism. As defined herein, computer readable storage media does not include communication media. Therefore, a computer storage or memory medium should not be interpreted to be a propagating signal per se or stated another transitory in nature. The propagated signals may be present in a computer storage media, but propagated signals per se are not examples of computer storage media, which is intended to be non-transitory. Although the computer memory or storage unit **564**, **538** is shown within the computing device **600** it will be appreciated that the storage may be distributed or located remotely and accessed via a network or other communication link.

FIG. **10** depicts an embodiment in which the main processor **530** communicates directly with cache memory **562** via a secondary bus, sometimes referred to as a backside bus. In other embodiments, the main processor **530** communicates with cache memory **562** using the system bus **570**. Cache memory **562** typically has a faster response time than main memory **564** and is typically provided by SRAM, B SRAM, or EDRAM. In the embodiment shown in FIG. **10**, the processor **530** communicates with various I/O devices **560** via a local system bus **570**. Various buses may be used to connect the central processing unit **530** to any of the I/O devices **560**, including a PCI bus, a PCI-X bus, or a PCI-Express bus, or a NuBus. For embodiments in which the I/O device is a video display **546**, the processor **530** may use an Advanced Graphics Port (AGP) to communicate with the display **546** or the I/O controller **544** for the display **546**. FIG. **10** depicts an embodiment of a computer **600** in which the main processor **530** communicates directly with I/O device **560***b* or other processors **530** via HYPERTRANSPORT, RAPIDIO, or INFINIBAND communications technology. FIG. **10** also depicts an embodiment in which local busses and direct communication are mixed: the processor **530** communicates with I/O device **560***a* using a local interconnect bus while communicating with I/O device **560***b* directly.

A wide variety of I/O devices **560***a*-**560***n* may be present in the computing device **600**. Input devices may include keyboards, mice, trackpads, trackballs, touchpads, touch mice, multi-touch touchpads and touch mice, microphones, multi-array microphones, drawing tablets, cameras, single-lens reflex camera (SLR), digital SLR (DSLR), CMOS sensors, accelerometers, infrared optical sensors, pressure sensors, magnetometer sensors, angular rate sensors, depth sensors, proximity sensors, ambient light sensors, gyroscopic sensors, or other sensors. Output devices may include video displays, graphical displays, speakers, headphones, and printers such as inkjet printers, laser printers, and 3D printers.

Devices **560***a*-**560***n* may include a combination of multiple input or output devices, including, e.g., Microsoft KINECT, Nintendo Wiimote for the WII, Nintendo WII U GAMEPAD, or Apple IPHONE. Some devices **560***a*-**560***n* allow gesture recognition inputs through combining some of the inputs and outputs. Some devices **560***a*-**560***n* provides for facial recognition which may be utilized as an input for different purposes including authentication and other commands. Some devices **560***a*-**560***n* provides for voice recognition and inputs, including, e.g., Microsoft KINECT, SIRI for IPHONE by Apple, Amazon Alexa, Google Now or Google Voice Search.

Additional devices **560***a*-**560***n* have both input and output capabilities, including, e.g., haptic feedback devices, touchscreen displays, or multi-touch displays. Touchscreen, multi-touch displays, touchpads, touch mice, or other touch sensing devices may use different technologies to sense touch, including, e.g., capacitive, surface capacitive, projected capacitive touch (PCT), in-cell capacitive, resistive, infrared, waveguide, dispersive signal touch (DST), in-cell

optical, surface acoustic wave (SAW), bending wave touch (BWT), or force-based sensing technologies. Some multi-touch devices may allow two or more contact points with the surface, allowing advanced functionality including, e.g., pinch, spread, rotate, scroll, or other gestures. Some touch-screen devices, including, e.g., Microsoft PIXEL SENSE or Multi-Touch Collaboration Wall, may have larger surfaces, such as on a table-top or on a wall, and may also interact with other electronic devices. Some I/O devices **560***a*-**560***n*, display devices **546***a*-**546***n* or group of devices may be augment reality devices. The I/O devices may be controlled by an I/O controller **44** as shown in FIG. **9**. The I/O controller may control one or more I/O devices, such as, e.g., a keyboard **548** and a pointing device **550**, e.g., a mouse or optical pen. Furthermore, an I/O device may also provide storage and/or an installation medium **540** for the computing device **600**. In still other embodiments, the computing device **600** may provide USB connections (not shown) to receive handheld USB storage devices. In further embodiments, an I/O device **560** may be a bridge between the system bus **570** and an external communication bus, e.g. a USB bus, a SCSI bus, a FireWire bus, an Ethernet bus, a Gigabit Ethernet bus, a Fibre Channel bus, or a Thunderbolt bus.

In some embodiments, display devices **546***a*-**546***n* may be connected to I/O controller **544**. Display devices may include, e.g., liquid crystal displays (LCD), thin film transistor LCD (TFT-LCD), blue phase LCD, electronic papers (e-ink) displays, flexile displays, light emitting diode displays (LED), digital light processing (DLP) displays, liquid crystal on silicon (LCOS) displays, organic light-emitting diode (OLED) displays, active-matrix organic light-emitting diode (AMOLED) displays, liquid crystal laser displays, time-multiplexed optical shutter (TMOS) displays, or 3D displays. Examples of 3D displays may use, e.g. stereoscopy, polarization filters, active shutters, or autostereoscopy. Display devices **546***a*-**546***n* may also be a head-mounted display (HMD). In some embodiments, display devices **546***a*-**546***n* or the corresponding I/O controllers **544** may be controlled through or have hardware support for OPENGL or DIRECTX API or other graphics libraries.

In some embodiments, the computing device **600** may include or connect to multiple display devices **546***a*-**546***n*, which each may be of the same or different type and/or form. As such, any of the I/O devices **560***a*-**560***n* and/or the I/O controller **544** may include any type and/or form of suitable hardware, software, or combination of hardware and software to support, enable or provide for the connection and use of multiple display devices **546***a*-**546***n* by the computing device **600**. For example, the computing device **600** may include any type and/or form of video adapter, video card, driver, and/or library to interface, communicate, connect or otherwise use the display devices **546***a*-**546***n*. In one embodiment, a video adapter may include multiple connectors to interface to multiple display devices **546***a*-**546***n*. In other embodiments, the computing device **600** may include multiple video adapters, with each video adapter connected to one or more of the display devices **546***a*-**546***n*. In some embodiments, any portion of the operating system of the computing device **600** may be configured for using multiple displays **546***a*-**546***n*. In other embodiments, one or more of the display devices **546***a*-**546***n* may be provided by one or more other computing devices **600***a* or **600***b* connected to the computing device **600**, via the network **514**. In some embodiments software may be designed and constructed to use another computer's display device as a second display device **546***a* for the computing device **600**. For example, in one embodiment, an Apple iPad may connect to a computing device **600** and use the display of the device **600** as an additional display screen that may be used as an extended desktop. One ordinarily skilled in the art will recognize and appreciate the various ways and embodiments that a computing device **600** may be configured to have multiple display devices **546***a*-**546***n*.

Referring again to FIG. **9**, the computing device **600** may comprise a storage device **538** (e.g. one or more hard disk drives or redundant arrays of independent disks) for storing an operating system or other related software, and for storing application software programs such as any program related to the software **580** for the order fulfillment system **10** of the present invention. Examples of storage devices **538** include, e.g., hard disk drive (HDD); optical drive including CD drive, DVD drive, or BLU-RAY drive; solid-state drive (SSD); USB flash drive; or any other device suitable for storing data. Some storage devices may include multiple volatile and non-volatile memories, including, e.g., solid state hybrid drives that combine hard disks with solid state cache. The storage device **538** may be non-volatile, mutable, or read-only. The storage device **538** may be internal and connect to the computing device **600** via a bus **570**. Further, the storage device **538** may be external and connect to the computing device **600** via an I/O device **560** that provides an external bus. Some storage devices **538** may connect to the computing device **600** via the network interface **542** over a network **514**, including, e.g., the Remote Disk for MACBOOK AIR by Apple. Some client devices **512** may not require a non-volatile storage device **538** and may be thin clients or zero clients **512**. The storage device **538** may also be used as an installation device **540**, and may be suitable for installing software and programs. Additionally, the operating system and the software can be run from a bootable medium, for example, a bootable CD, e.g. KNOPPIX, a bootable CD for GNU/Linux that is available as a GNU/Linux distribution from knoppix.net.

The computing device **600** may also install software or application from an application distribution platform. Examples of application distribution platforms include the App Store for iOS provided by Apple, Inc., the Mac App Store provided by Apple, Inc., GOOGLE PLAY for Android OS provided by Google Inc., Chrome Webstore for CHROME OS provided by Google Inc., and Amazon Appstore for Android OS and KINDLE FIRE provided by Amazon.com, Inc. An application distribution platform may facilitate installation of software on a client device **512**. An application distribution platform may include a repository of applications on a server **516** or a cloud **520**, which the clients **512***a*-**512***n* may access over a network **514**. An application distribution platform may include application developed and provided by various developers. A user of a client device **512** may select, purchase and/or download an application via the application distribution platform.

Furthermore, the computing device **600** may include a network interface **542** to interface to the network **514** through a variety of connections including, but not limited to, standard telephone lines LAN or WAN links (e.g., 802.11, T1, T3, Gigabit Ethernet, Infiniband), broadband connections (e.g., ISDN, Frame Relay, ATM, Gigabit Ethernet, Ethernet-over-SONET, ADSL, VDSL, BPON, GPON, fiber optical including FiOS), wireless connections, or some combination of any or all of the above. Connections can be established using a variety of communication protocols (e.g., TCP/IP, Ethernet, ARCNET, SONET, SDH, Fiber Distributed Data Interface (FDDI), IEEE 802.11a/b/g/n/ac CDMA, GSM, WiMax and direct asynchronous connec-

tions). In one embodiment, the computing device **600** communicates with other computing devices **600'** via any type and/or form of gateway or tunneling protocol e.g. Secure Socket Layer (SSL) or Transport Layer Security (TLS), or the Citrix Gateway Protocol manufactured by Citrix Systems, Inc. of Ft. Lauderdale, Fla. The network interface **542** may comprise a built-in network adapter, network interface card, PCMCIA network card, EXPRESSCARD network card, card bus network adapter, wireless network adapter, USB network adapter, modem or any other device suitable for interfacing the computing device **600** to any type of network capable of communication and performing the operations described herein.

The computing device **600** of the sort depicted in FIG. **9** may operate under the control of an operating system, which controls scheduling of tasks and access to system resources. The computing device **600** can be running any operating system such as any of the versions of the MICROSOFT WINDOWS operating systems, the different releases of the Unix and Linux operating systems, any version of the MAC OS for Macintosh computers, any embedded operating system, any real-time operating system, any open source operating system, any proprietary operating system, any operating systems for mobile computing devices, or any other operating system capable of running on the computing device and performing the operations described herein. Typical operating systems include, but are not limited to: WINDOWS 2000, WINDOWS Server 2012, WINDOWS CE, WINDOWS Phone, WINDOWS XP, WINDOWS VISTA, and WINDOWS 7, WINDOWS RT, and WINDOWS 8 all of which are manufactured by Microsoft Corporation of Redmond, Wash.; MAC OS and iOS, manufactured by Apple, Inc. of Cupertino, Calif.; and Linux, a freely-available operating system, e.g. Linux Mint distribution ("distro") or Ubuntu, distributed by Canonical Ltd. of London, United Kingom; or Unix or other Unix-like derivative operating systems; and Android, designed by Google, of Mountain View, Calif., among others. Some operating systems, including, e.g., the CHROME OS by Google, may be used on zero clients or thin clients, including, e.g., CHROMEBOOK S.

The computer system **600** can be any workstation, telephone, desktop computer, laptop or notebook computer, netbook, ULTRABOOK, tablet, server, handheld computer, mobile telephone, smartphone or other portable telecommunications device, media playing device, a gaming system, mobile computing device, or any other type and/or form of computing, telecommunications or media device that is capable of communication. The computer system **600** has sufficient processor power and memory capacity to perform the operations described herein. In some embodiments, the computing device **600** may have different processors, operating systems, and input devices consistent with the device. The Samsung GALAXY smartphones, e.g., operate under the control of Android operating system developed by Google, Inc. GALAXY smartphones receive input via a touch interface.

In some embodiments, the computing device **600** is a digital audio player such as the Apple IPOD, IPOD Touch, and IPOD NANO lines of devices, manufactured by Apple Computer of Cupertino, Calif. Some digital audio players may have other functionality, including, e.g., a gaming system or any functionality made available by an application from a digital application distribution platform. For example, the IPOD Touch may access the Apple App Store. In some embodiments, the computing device **600** is a portable media player or digital audio player supporting file formats including, but not limited to, MP3, WAV, M4A/AAC, WMA Protected AAC, AIFF, Audible audiobook, Apple Lossless audio file formats and .mov, .m4v, and .mp4 MPEG-4 (H.264/MPEG-4 AVC) video file formats.

In some embodiments, the computing device **600** is a tablet e.g. the IPAD line of devices by Apple; GALAXY TAB family of devices by Samsung; or KINDLE FIRE, by Amazon.com, Inc. of Seattle, Wash. In other embodiments, the computing device **600** is an eBook reader, e.g. the KINDLE family of devices by Amazon.com, or NOOK family of devices by Barnes & Noble, Inc. of New York City, N.Y.

In some embodiments, the computing device **600** includes a combination of devices, e.g. a smartphone combined with a digital audio player or portable media player. For example, one of these embodiments is a smartphone, e.g. the IPHONE family of smartphones manufactured by Apple, Inc.; a Samsung GALAXY family of smartphones manufactured by Samsung, Inc; or a Motorola DROID family of smartphones. In yet another embodiment, the computing device **600** is a laptop or desktop computer equipped with a web browser and a microphone and speaker system, e.g. a telephony headset. In these embodiments, the computing devices **600** are web-enabled and can receive and initiate phone calls. In some embodiments, a laptop or a desktop computer is also equipped with a webcam or other video capture device that enables video chat and video call. In some embodiments, the computing device **600** is a wearable mobile computing device including but not limited to Google Glass and Samsung Gear.

In some embodiments, the status of one or more machines **512**, **516** in the network **514** is monitored, generally as part of network management. In one of these embodiments, the status of a machine may include an identification of load information (e.g., the number of processes on the machine, CPU and memory utilization), of port information (e.g., the number of available communication ports and the port addresses), or of session status (e.g., the duration and type of processes, and whether a process is active or idle). In another of these embodiments, this information may be identified by a plurality of metrics, and the plurality of metrics can be applied at least in part towards decisions in load distribution, network traffic management, and network failure recovery as well as any aspects of operations of the present solution described herein. Aspects of the operating environments and components described above will become apparent in the context of the order fulfillment system disclosed herein.

The foregoing description may provide illustration and description of various embodiments of the invention, but is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications and variations of the order fulfillment system of the present invention may be possible in light of the above teachings or may be acquired from practice of the invention. For example, while a series of acts has been described above, the order of the acts may be modified in other implementations consistent with the principles of the invention. Further, non-dependent acts may be performed in parallel.

In addition, one or more implementations consistent with principles of the invention may be implemented using one or more devices and/or configurations other than those illustrated in the Figures and described in the Specification without departing from the spirit of the invention. One or more devices and/or components may be added and/or removed from the implementations of the figures depending on specific deployments and/or applications. Also, one or more disclosed implementations may not be limited to a

specific combination of hardware. Furthermore, certain portions of the invention may be implemented as logic that may perform one or more functions. This logic may include hardware, such as hardwired logic, an application-specific integrated circuit, a field programmable gate array, a microprocessor, software, or a combination of hardware and software.

No element, act, or instruction used in the description of the invention should be construed critical or essential to the invention unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items. Where only one item is intended, the term "a single" or similar language is used. Further, the phrase "based on," as used herein is intended to mean "based, at least in part, on" unless explicitly stated otherwise. In addition, the term "user", as used herein, is intended to be broadly interpreted to include, for example, an electronic device (e.g., a workstation) or a user of an electronic device, unless otherwise stated.

Further, the invention can be employed using any combination of features or elements as described above, and are not limited to the current recited steps or features.

It is intended that the invention not be limited to the particular embodiments disclosed above, but that the invention will include any and all particular embodiments and equivalents falling within the scope of the following appended claims.

We claim:

1. A customer order fulfillment system, comprising

an order collection unit for collecting information associated with a plurality of customer orders from a plurality of customers and generating customer order data that includes data associated with each of the plurality of customer orders and the plurality of customers, wherein each of the plurality of customer order includes one or more items associated therewith,

an order generating unit for receiving the customer order data from the order collection unit and generating in response thereto consolidated order fulfillment data,

a bulk pick order fulfillment unit for receiving the consolidated order fulfillment data from the order generating unit and grouping together similar ones of the items associated with the plurality of customer orders to form a plurality of bulk picks, wherein one or more of the plurality of bulk picks can form part of one or more bulk pick tours, and

a pick tour generating unit for receiving the consolidated order fulfillment data from the order generating unit and for generating pick tour instructions associated with a pick tour from the consolidated order fulfillment data, wherein the pick tour instructions selectively includes the bulk picks,

wherein the bulk pick order fulfillment unit groups selected ones of the items of the plurality of customer orders in the consolidated order fulfillment data into the bulk picks based on a plurality of selectable predetermined logical parameters, including warehouse data and data associated with the items that are common among a selected group of items, so as to optimize a fulfillment process, and

wherein the bulk pick order fulfillment unit includes processing hardware that is configured to generate one or more bulk picks having associated therewith a plurality of bulk pick recipes from the data associated with the customer orders and the warehouse data including one or more locations in the warehouse, wherein each of the bulk pick recipes includes a selected quantity of different ones of the one or more items from different ones of the plurality of customer orders that are grouped together.

2. The customer order fulfillment system of claim **1**, wherein the bulk pick order fulfillment unit includes processing hardware that is configured to

generate a bulk pick ticket associated with each of the bulk picks, wherein the bulk pick ticket includes information about the one or more items in the bulk pick recipe, including a description of the item, and image of the item and a number of the items to be selected, and the location of the item in the warehouse.

3. The customer order fulfillment system of claim **1**, wherein the bulk pick order fulfillment unit generates the one or more bulk pick recipes by using a connected graph of groupings of the items from the customer orders and one or more additional items, wherein the items from the customer orders and the additional items form nodes of the connected graph, and wherein the connected graph includes a plurality of connecting lines coupled to one or more of the nodes and which are representative of a number of the customers associated with the nodes that are connected by the connecting lines.

4. The customer order fulfillment system of claim **3**, wherein one of the order generating unit and the bulk pick order fulfillment unit generates a window having a tree map for visually displaying on a display device selected consolidated order fulfillment data.

5. The customer order fulfillment system of claim **4**, wherein the window includes

a top pane for displaying the selectable logical parameters for allowing a user to select parameters associated with the customer orders, and wherein the selectable parameters include a plurality of a selectable warehouse location, a maximum number of items per bulk pick ticket, a minimum shipment count per bulk pick recipe, a maximum number of recipes per bulk pick, a selectable fulfillment line type, and a selectable pick location, wherein each of the recipes includes a selected number of items from the customer orders,

a plurality of bottom panes forming the tree map, wherein each of the plurality of bottom panes is representative of a total number of customer orders included in a bulk pick, and wherein each of the plurality of bottom pane elements has a different size relative to each other and is representative of a different number of bulk picks, wherein the plurality of bottom panes are arranged in order of the number of bulk picks.

6. The customer order fulfillment system of claim **5**, wherein the processing hardware is configured to group items in the customer orders into bulk picks for shipment based on a plurality of logical rules, wherein the plurality of logical rules includes payment status of the customer rule, destination address of the customer rule, one or more services associated with one or more items in the customer order rule including sizing of the item and appraisal of the item, and a shipping option rule.

7. The customer order fulfillment system of claim **6**, wherein the processing hardware is configured to schedule the bulk pick tour based on a plurality of logical rules including time of day, a number of customer orders, and a number of pick agents assigned to the warehouse.

8. The customer order fulfillment system of claim of claim **3**, wherein the processing hardware of the bulk pick order fulfillment unit is further configured to allow a user to select a maximum number of recipes per bulk pick, a maximum number of items per bulk pick and a minimum number of

bulk groups per bulk pick, and wherein the bulk pick order fulfillment unit determines a number of items per bulk pick recipe and a total number of bulk picks.

9. The customer order fulfillment system of claim **1**, further comprising an automated fulfillment sub-system for automatically retrieving the items that form the bulk pick or that form the pick tour.

10. The customer order fulfillment system of claim **1**, further comprising a packing and shipping sub-system for packing and shipping the items from the customer orders.

11. A computer-implemented method, comprising

collecting information associated with a plurality of customer orders from a plurality of customers and generating customer order data that includes data associated with each of the plurality of customer orders and the plurality of customers, wherein each of the plurality of customer order includes one or more items associated therewith,

generating in response to the customer order data consolidated order fulfillment data,

grouping together similar ones of the items associated with the plurality of customer orders to form a plurality of bulk picks based on a plurality of selectable logical parameters, including warehouse data and data associated with the items that are common among a selected group of items so as to optimize a fulfillment process, wherein one or more of the plurality of bulk picks can form part of one or more bulk pick tours,

generating one or more bulk picks having associated therewith a plurality of bulk pick recipes from the data associated with the customer orders and the warehouse data including one or more locations in the warehouse, wherein each of the bulk pick recipes includes a selected quantity of different ones of the one or more items from the plurality of customer orders that are grouped together, and

generating pick tour instructions associated with a pick tour from the consolidated order fulfillment data.

12. The computer-implemented method of claim **11**, further comprising

generating a bulk pick ticket associated with each of the bulk picks, wherein the bulk pick ticket includes information about the one or more items in the bulk pick recipe, including a description of the item, and image of the item and a number of the item to selected, and the location of the item in the warehouse.

13. The computer-implemented method of claim **11**, further comprising generating the one or more bulk pick recipes using a connected graph of groupings of the items from the customer orders and the one or more additional items, wherein the items from the customer orders and the additional items form nodes of the connected graph, and wherein the connected graph includes a plurality of connecting lines coupled to the nodes and which are representative of a number of the items in a plurality of the customer orders.

14. The computer-implemented method of claim **13**, further comprising generating a window having a tree map for visually displaying on a display device selected consolidated order fulfillment data.

15. The computer-implemented method of claim **14**, wherein the window comprises

a top pane having the selectable logical parameters for allowing a user to select parameters associated with the customer orders, and wherein the selectable parameters include a selectable warehouse location, a maximum number of items per bulk pick ticket, a minimum shipment count per bulk pick recipe, and a maximum number of recipes per bulk pick, a selectable fulfillment line type, and a selectable pick location, wherein each of the recipes includes a selected number of items from the customer orders,

a plurality of bottom panes forming the tree map, wherein each of the plurality of bottom panes is representative of a total number of customer orders included in a bulk pick, and wherein each of the plurality of bottom pane elements has a different size relative to each other and is representative of a different number of bulk picks, wherein the plurality of bottom panes are arranged in order of the number of bulk picks.

16. The computer-implemented method of claim **15**, further comprising grouping items in the customer orders into bulk picks for shipment based on a plurality of logical rules, wherein the plurality of logical rules includes payment status of the customer rule, destination address of the customer rule, one or more services associated with one or more items in the customer order rule including sizing of the item and appraisal of the item, and a shipping option rule.

17. The computer-implemented method of claim **16**, further comprising scheduling the bulk pick tour based on a plurality of logical rules including time of day, a number of customer orders, and a number of pick agents assigned to the warehouse.

18. The computer-implemented method of claim **13**, further comprising selecting a maximum number of recipes per bulk pick, a maximum number of items per bulk pick and a minimum number of bulk groups per bulk pick, and determining a number of items per bulk pick recipe and a total number of bulk picks.

* * * * *